SAFE CHILDBIRTH:

THE THREE ESSENTIALS

1. ROUND BRIM
2. FLEXIBLE JOINTS
3. NATURAL POSTURE

BY

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FOREWORD

It is curious, when dangers of war seem past and commerce and finances begin to flourish, how quickly the philosophy of life swings over on to an optimistic upgrade and we begin to adjust our statistics as we hail the prospective speedy arrival of the Superman; of the Superwoman, alas, we don't hear so much.

Doctor Kathleen Vaughan, however, in this timely book, utters a warning as she shows from unquestionable statistics the enormous, culpable losses in so-called civilized lands of the lives of mothers and children due to our utterly uncivilized treatment of expectant and parturient mothers. These evils, she reveals, hark back to childhood and its restraints, to the lack of sunshine, proper exercise, clothing, and food, and faulty school habits, with the common bad habits during pregnancy, followed by postural errors which prevent the necessary expansion of the birth canal during parturition. While such facts have been adverted to from time to time, Doctor Vaughan presents them *en masse* with such an array of impressive data and clear reasoning, based on an analysis of the customs of many nations and primitive peoples, that her book must impress every reader as a work of enormous value.

Whether all the doctor's conclusions are at once accepted or not, it is of vital importance that they be most carefully considered and duly weighed. If she be right, as I believe, our methods in bringing up our girls and the habits of our women with many of the customs of "civilized" life must be radically readjusted.

As a striking illustration, it is interesting to note that side by side with the extreme instances of violation of obvious sanitary laws in all the purdahs of India, we find the strikingly impressive, notable exceptions of normal healthy childbearing in the sturdy

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river women, born, growing up, and living on the transport river-boats of Kashmir.

Before such a wealth of clearly and logically presented, challenging data, preconceived notions regarding these vital matters should be held in abeyance until we have given the matter our fullest and fairest consideration.

HOWARD A. KELLY.

BALTIMORE,
6th October, 1936.

AUTHOR'S INTRODUCTION

WHEN I began my enquiry into the cause of difficulty in childbirth I had no idea where it would lead me and I had no thought of publishing my results.

Instead of taking a few months it has taken years.

I began by trying to find the underlying factors which make for safety in every birth, and then I hoped to see how far we failed to fulfil those requirements in our accepted practice.

It was necessary to cast the net widely in the hope of bringing ashore some small grains of truth even from unlikely waters. Anthropology, medicine, veterinary science, anatomy, obstetrics, bio-chemistry, religion and tradition, to mention only a few, have all been laid under contribution in the effort to discover why human childbirth is a matter of increasing difficulty.

The result of my enquiry leads me to the conclusion that the essential factors which make for the safety of mother and child in every birth are the round pelvis, mobile pelvic joints, and the use of the natural posture for delivery.

These are all characteristic of the healthy woman, to whatever race she belongs.

Difficult childbirth is not a matter of chance, nor is it dependent upon the will of Heaven, but it follows the violation of the fundamental laws of health.

In all countries extremes meet and the indoor and pampered life of the rich gives rise to more difficulties than extreme poverty and bad housing.

Late marriages so common among the over-civilized mean rigid joints and delay in parturition. However strong and well the infant before birth, that passage through a stiff and unyielding pelvis may well render the highest mental endowment abortive.

Efficient childbearing requires at least as much selection and training as does success in athletic sports.

Children are always interested in birth, but convention decrees ignorance. Hence mystery and fear too often surround the con-

finement when we need calm, trained, purposeful action on the part of the mother.

It is true to say that human progress is only possible through birth, but we usually forget that it is the *quality* of our births that is the unseen cause of the rise and fall both of families and nations and is the determining factor in man's slow evolution. This quality rests with ourselves in much larger measure than we care to acknowledge.

The object of this book is a practical one: to simplify our attendance on childbirth while making it a safer and easier process for both mother and child.

I must express my thanks to my old friend Dr. Howard Kelly for his encouragement and for his commendation of my work.

It would take too long to mention by name all my friends who have given me their aid, and have freely placed their knowledge at my disposal, in museums, libraries, and hospitals. I owed the success of my French tour to the help and kindness extended to me by Monsieur and Madame V. Pecker, of Bordeaux. My thanks are due to Dr. J. R. C. Stephens for Plate VII.; to Dr. Violet Hastings, of New Zealand; to Mr. E. R. Darnley for the illustration on p. 47; and to many others who have given me encouragement from all parts of the world.

My work has shown me that childbirth affords a common meeting ground for all mankind.

KATHLEEN VAUGHAN.

LONDON,
November, 1936.

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SAFE CHILDBIRTH:

THE THREE ESSENTIALS

CHAPTER I

THE PROBLEM OF DIFFICULT CHILDBIRTH

TELL any British citizen that over three thousand mothers die annually in England and Wales as a result of child-bearing, and conditions associated therewith, and he can hardly believe such a thing possible; yet the death-roll of mothers in childbirth is something that demands the interested attention of everyone, men as well as women, because it indicates something seriously wrong with the race at its point of entry into the world, and we may regard the number of women who die in childbirth as a rough index to the rate at which any nation is going downhill; for example, in Kashmir, where the worst confinements take place among the Hindu women (known as Punditanis), their race shows a steady annual decrease estimated at nearly 1,000 every year. These people fight for their political rights and try to maintain their old ascendancy, but they do not see any more than we do in Europe that a race losing mothers and sons at birth is a dying race, degeneration has begun at the very source of life and if unchecked must proceed to its natural end. Now in England these deaths do not arouse the interest of every man and woman as they should. Compare the interest taken by the ordinary citizen in the Women's Suffrage movement with any real practical interest taken in the subject of childbirth, the difference is striking.

I believe this is due to the curious and superstitious idea persisting even to-day that this is "the lot of woman," and we are still reminded by an older generation that suffering and death are decreed for her in the Book of Genesis for her transgression, although I have never met anyone, man or woman, who considered that the parallel pronouncement of hard manual labour on

the land for daily bread until his sweat ran down his face was in any sense now binding on civilized man. If it were, we might have less unemployment, better and cheaper food, and no doubt less illness and less crime so often directly caused by an indoor and artificial life. And many more people, who read neither Government reports nor their Bible, think that what puzzles the doctors can be no concern of theirs, and so dismiss these unpleasant and disquieting facts from consideration.

We must face it that the subject of birth is an unpopular one, perhaps due to the modern emphasis on sex to the exclusion of childbirth, a phase common to all civilizations when they have reached a certain pitch, when the pleasure of the individual in the immediate present has become of more account than the well-being and progress of the race in the future.

In the Western world there is a very real antagonism between the two, shown by the abnormal amount of thought and interest given to sex, and the strange indifference and even antagonism shown towards the idea of childbirth: but one has only to live in the East for a few years to become aware of another point of view and to see how the desire for healthy offspring can dominate the whole conception of marriage, so that when there are several wives the ugly one who has children is preferred to the childless woman whatever her beauty, for among them the race takes precedence of the merely personal interests and preferences of the individual.

The late Sir Walter Fletcher, Secretary of the Medical Research Council, in the *Practitioner* of 1932 told us that over fifty women die in childbed every week in England and Wales alone, and of these no less than twenty a week die from septic infection.

The Ministry of Health Report on Maternal Mortality, 1932, states that in spite of greater care given to the expectant mother by means of ante-natal clinics and more highly skilled attendance during childbirth from both doctor and midwife, with the provision of new maternity hospitals where the most up-to-date methods are followed, yet with all this concentrated effort and increased expenditure, our maternal death rate shows no real reduction in the last twenty-five years. During the period under review our birth rate has fallen so greatly that proportionately there are fewer women facing the risks of maternity than before

by one-third, yet the maternal mortality figures remain the same, and there is improvement in all death rates except in those recording the deaths of mothers in childbirth.

Sir George Newman wrote in his very full Report on Maternal Mortality, 1930, that "in spite of the efforts made and arrangements designed to reduce this death rate the position remains, on the whole, unimproved."

In the same report, p. 103, we read that "it is an issue which involves the survival of a nation when it is estimated that out of six or seven hundred thousand confinements, *we lose three thousand mothers every year*, and this number does not include those so injured that they die later, or those whose health is impaired for life.

"Most of these young women who die in making their contribution to the race are each the mother of a home and the trainer of a family." The report continues, "We regard these deaths with remorse, and a feeling that they could have been prevented if we only had known how"; and Sir George says, "This is no ordinary medical issue . . . it is an issue of civilization in origin and in solution."

Careful investigation of the causes of death were made by means of a questionnaire:

Were the midwives or the doctors to blame?

Was the fault due to neglect before birth, errors in treatment at the time of birth, want of medical care, or carelessness on the part of the patient in failing to carry out instructions?

The answers indicated that:

(*a*) In more than half of the deaths (52 per cent.) no avoidable cause could be found.

(*b*) In one-third of all the cases the death was due to sepsis, commonly known as puerperal fever.

Four recommendations are made in the Report:

1. Better education of medical students.
2. More care of the expectant mother.
3. Improvement of medical practice.
4. Co-ordination of all agencies dealing with midwifery.

But the strange fact is noted that many maternity cases did extremely well with the minimum of experienced aid and in the poorest surroundings! The handy woman with no training comes

out of the enquiry remarkably well, as do the patients confined in their own homes compared with those in hospitals.

The recent Report of the Ministry of Health for 1934 says (p. 44) "that as a detailed survey was published in 1933, this year it is proposed therefore to refer mainly to certain special features which call for notice.

"The subject of outstanding interest in this field has been the maternal death rate, which, in spite of many recognized improvements in provision for maternal care, has again in 1934 showed no reduction but on the contrary a slight increase. The persistence, with little variation, of this death rate, in striking contrast to the reduction in recent years in the general and the infant death rates of the country, is a fact which has not yet been adequately explained and which is still in its various aspects the subject of consideration by medical and social workers."

After elaborate and careful investigation the chief cause put forward as responsible for the deaths of mothers in childbirth is sepsis. The Annual Report of the Chief Medical Officer of the Ministry of Health, 1934, puts the matter plainly, and we see from the above that no improvement has taken place in the figures during the last twenty-five years.

The table on p. 45 of this report shows the annual returns for maternal mortality from 1911 to 1934—twenty-four years—and although the total number of births is much fewer now than then (881,138 in 1911 and 597,640 in 1934), the maternal mortality rate has steadily risen from 3·87 per thousand to 4·60 to-day. Also of ominous significance, the deaths from sepsis in 1911 were 1·43 per thousand and are now 2·03 per thousand live births. Then again we read that the total number of women who lost their lives in child-bearing in 1934 was 2,748, and if we add the deaths not actually due to parturition but closely associated with it we find 747 more—total 3,495, just under four thousand women in one year who lost their lives giving birth to the next generation.

Out of these 2,748 deaths 1,212 are returned as *directly due to sepsis*. That is over half.

So that all our efforts to make motherhood safer during the last twenty-five years have not yet been crowned with success. It is this fact, that in spite of great and increasing care, sepsis is still with us, that makes so many workers on the problem direct all

their attention to this one point, so that if one speaks to them of the fundamental causes of difficult childbirth they frankly state they are focussing on the life history of the hæmolytic streptococcus, and have no time to give to other aspects of the problem.

But sepsis only enters at the end when the primary requirements of safe childbirth are wanting, for another Ministry of Health Report (No. 68) dealing with causes of high maternal mortality in certain areas (1932) states, "It is probable that a high death rate from puerperal sepsis is mainly a sequel to difficult labour, and that bad housing is not associated with a high stillbirth and neo-natal death rate." The opinion is expressed that the presence of rickets in industrial towns is a contributory cause.

But the infants, how are they affected? Their fate is so intimately bound up with the question of maternal mortality and difficult childbirth that it is perhaps a question of even more moment to the nation at large than any other, and it is a fact that these difficult and prolonged labours result in the *destruction* of the finest children and too often in the *survival* of the feeble-minded.

Many of those who manage to be born alive are premature, those with smaller heads, and consequently the females who have a better chance of surviving the modern ordeal of difficult birth, while the finest and biggest children suffer damage to the head, leading to bodily and mental defects, which prevent their ever being useful members of society even if they escape being stillborn. Whitridge Williams ("Obstetrics," p. 176) tells us that more boys are born at full term than girls, 106 to 100. The number is increased in elderly primiparæ. In abortions and premature labours the males still further outnumber the females, 110 to 100. At the onset of pregnancy they are 125 to 100, and he adds that sex is determined in the germ cells, primarily or immediately after their union, and is immutable by the time segmentation of the ovum begins.

Our infant mortality returns show that over half the number of infants dying before they are a year old die before they have lived a month (and 6,744 of them before they are twenty-four hours old), strongly suggesting that their vitality was impaired by the process of birth. The figures for those who did not survive one

month are 20,060, and of these *more than half are males. So we lose over ten thousand boys every year under a month old!* (Public Health Report, No. 55).

Hear what Dr. Peter McKinlay has to say on the subject. "The death rate of infants in the period immediately subsequent to birth is nine times as high as that which occurs later in the first years of life." He shows how the difficulty experienced by the mothers during parturition leads to the death of infants at and just after birth, and says in this connection, "Infant deaths under a month are significantly associated with the death rates of mothers in childbearing." He quotes Netherland statistics showing that of stillbirths due to difficulty during birth, *male* stillbirths predominate, and says, "These figures might be taken in support of the view that the greater size of the male head is a cause of some greater difficulty in labour than there is with a female birth."

Here, indeed, in civilized childbirth is the laboratory where the sex of the population is finally determined—the actual births of boys and girls are nearly equal in number, but the small ones slip through; the larger children are the ones who are killed during birth, or so damaged that life is heavily handicapped, and we are left with an enormous surplus female population.

This destruction of male infants, which goes on day by day and year by year, puts the consequences of the Great War into the shade. Our surplus female population (now reaching over one and a half million in excess of the male) is directly due to it. We have no need of Pharaoh's midwives to kill our boys off at birth (Exodus i. 16). Civilization does it unaided, for all civilized races as they pass their zenith and are on the downgrade have eventually had to face the same problem, the outnumbering of men by women, and most of them have met it as the East does to-day by female infanticide. A more intelligent policy would be to prevent the *males* dying at birth. We see that difficult childbirth leads to a high maternal mortality, but it is also the cause of a high infant mortality falling most heavily upon the male infants, and it is also responsible for the production of mental defectives in ever-increasing numbers.

For mental deficiency undoubtedly increases with civilization and difficulty in birth, but the gravity of the problem does not attract the attention it deserves, because we shut our idiots and

mental defectives away in homes and hospitals, where they are forgotten by the general public. Primitive races have few such people, but those few are seen, much as the village idiot who was once a well-recognized character in England. That he is still with us we have reason to know, for we have now over 300,000 mental defectives—*twice as many as there were twenty years ago*. The greater number of them, like the stillbirths, are males. In the Report of the Mental Deficiency Committee, 1929, we are told that mental defect is undoubtedly found in the same social grades where undersized stature, malnutrition, and anæmia are common, and that *many defectives are made by injury to the head during birth*.

In "The Health of the School Child," p. 106, we read: "The great majority of mentally defective children are not the offspring of mentally deficient parents," so that it would seem that conditions at and after birth are primarily responsible for our increasing mental degeneracy as a race.

Childbirth kills our mothers, and is often a cause of chronic invalidism.

It kills our infants.

It kills more boys than girls, and provides us with large numbers of mental defectives, amongst which males predominate.

Looking at these results from the eugenic standpoint, we need not be so elated at the reduction of our infant mortality rate, until we also know the quality of those infants whom we have preserved. What advantage is there to the nation in the survival of children with squeezed heads, who are mental defectives and lifelong cripples, or those who from birth till death will be merely a burden to themselves? Many of our modern citizens begin life in the incubator and end it in dependance on the State. To expect, and then to make provision for, more and more difficult and abnormal births is merely tinkering with the results of our over-civilization, without going to the root of the matter, which is to be found in the *mother herself*. A high rate of maternal mortality is always associated in a race with *all* birth (even normal cases) becoming increasingly difficult; and when we realize that each year maternity in the British Isles is more painful and risky for the mother and more and more fatal to our big healthy babies, is it not obvious that some factor in

the situation has been overlooked which is not touched by the provision of skilled obstetricians, trained midwives, and any number of perfectly appointed lying-in hospitals, however efficient?

The race with a high maternal mortality rate is a declining race, nor will a low infant mortality rate counteract its lethal effects, for it is the less hardy and vigorous, the deformed, and the mentally defective who would in more natural surroundings have failed to survive, that civilization with meticulous care preserves. Again, an excess of one sex over the other brings with it curious social consequences, when it is a female excess as in England, or a male excess as in Thibet, Ladakh, and other places, and either excess is a source of racial weakness not yet sufficiently realized or studied by our social reformers.

Is it unreasonable to suggest that it is civilization that is at fault, and that it is bringing itself to an end by creating conditions of life that so deform the skeleton of the race that the woman's pelvis is no longer capable of allowing her infant's head to pass without danger and damage to herself, and death or gross head injury to her child?

And yet there are districts in the British Isles where whole communities still bear fine children with little trouble and with safety to both mother and child, *and where death in childbirth is practically unknown.*

The Carnegie Trust Report, 1913, gives interesting accounts of conditions obtaining in the Highlands, in the Outer Hebrides in fishing villages, and in Shetland, the conditions of life in many cases being most primitive, the women working on the land and helping with the fishing; and yet in many of these places no deaths are reported in childbirth.

The Report is a little difficult to follow as the names of the districts are not given, but we owe a debt to those who, in difficult circumstances, have given us a most living and realistic account of human life, and from these reports from inaccessible districts in Scotland we dig out the prominent facts that hard work in field or with nets is good for the women, and that outdoor life, however rough, with simple plain coarse food, absence of comfort and even of chairs or any closet other than a ditch or pail is not inimical to safe and healthy childbearing. The disposal of sewage in tubs in some of the houses, or in the ashpit in close proximity, seemed to

have very little influence on the mothers, and in these places there were no deaths in childbirth (I presume because in spite of sewage in the ashpit, the women lived healthy natural lives and were proof against infection) (p. 416). One district in the Highlands is described, the houses being turf hovels with thatched roof and earthen flooring. Inside were casks of human urine, preserved for use in the dyeing of homespuns; here also the cattle byre communicated with the dwelling, calves, pet lambs, and poultry having the run of the house. "Only the open-air life preserved the race. Water of the purest quality everywhere. No sanitary arrangements in the cottages. Except for inconvenience no health danger arises in consequence. . . . The time-honoured custom of casting liquid and solid excretions together with organic domestic refuse on to the midden, too often situated within hand-throw of the house door, constitutes a very real danger." But it is pointed out that the crofts are well separated from each other and no disorders arise. "The food consists of oatmeal, potatoes, fish, fowl and eggs, with purchases of bacon, meat, flour, etc. The women lead a laborious but healthy life." From the Outer Hebrides: "A woman of 43, wife of a labourer, eighth confinement, twins, no difficulty, twelve children alive."

Another case of twelve children, and the doctor states, "they are splendid specimens of young humanity."

The fourteenth confinement of another woman is described where forceps were needed because of uterine inertia. The children grew up strong and healthy; "open-air and a copious milk supply is their salvation," and a note is added to the effect that "the housekeeping is distinguished by apparent belief in the doctrine that 'dirt is healthy.'"

Dr. Mary Menzies gives an account of life in the Outer Hebrides and quotes one woman with a family of nine, who said, "God bless them, I got them all without a doctor." She reports no rickets, good teeth common, all breast-fed, and a low infantile mortality in spite of unspeakably bad local conditions. She remarks on the beautiful teeth seen among adults in the Island of Lewis, and points out that it is "a testimony to the absence of rickets in their infancy," but the report is so written that it is impossible to find out if the districts where absence of rickets and no decayed teeth are noted are the same as those where there were

no maternal deaths, a point of considerable interest and importance.

In the west of Lewis and in Harris puerperal fever is very rare (p. 452), and the doctor said he did not usually attend confinements (presumably because he was not needed).

In North Uist the doctor reports only three deaths from septicæmia (puerperal fever) since he came to the district thirty years ago. The nurse there has seen "no difficult labours or cases of contracted pelvis, no puerperal fever. Breast feeding goes on for ten months and there is no rickets." A doctor on the East Coast describes how in his district the people have "a total absence of water-closet accommodation, 'the villagers using the rocks.' The houses are clean and comfortable, and one case of puerperal fever occurred in the past five years, no deaths among mothers in childbirth."

Another rural population is described (p. 468) where puerperal fever and maternal deaths are unknown.

Dr. Bremner reports on a fishing village in Sutherlandshire, whose inhabitants number about 600 and are the descendants of crofters evicted from central parts of the county four or five generations ago. He reports the sanitary conditions as being unsatisfactory, the houses consist of two rooms and one small compartment—the lines are always baited in the kitchen in winter and cleaning up afterwards is not attended to as it should be. Bedding and clothes are not kept clean as the mother is out most of the day. No water-closets exist—overcrowding common. A local lady gave a nursing home with two beds for confinements. After ten years only two women had made use of it, because Highland women have "an inherent desire to be confined in their own homes"! The nurse attends all confinements. No deaths in childbirth are reported, although the mortality among infants is high.

The women lead a very hard life. A typical day of a fisherman's wife is as follows:

"Gets up early, about 3 or 4 a.m. Makes husband's breakfast. After breakfast walks to pier, three-quarters of a mile away. She goes bare-legged summer and winter, wearing only sand-shoes on her feet. The pier is not very satisfactory, and the boats cannot be got at without wading. To keep the husband dry while at

sea the wife carries him out to the boat on her back, wading in so doing well above the knees. The same procedure is gone through again when the boats come back, though one would think the ostensible reason does not then hold good. The scene at the pier on a cold winter morning is interesting, but somewhat pathetic to a stranger. Women wading through icy water, their petticoats fastened up round their waist, each with her man on her back. One wife who had married into this village from Portmahomack (in Ross-shire) refused to carry her husband in this way, and the result was that she not only quarrelled with her husband, but became the scoff and scorn of all the other women.

"After seeing her husband safely out to sea, the wife comes home, prepares the children's breakfast, and gets them ready for school. The rest of her day is spent as follows: (*a*) Collecting firewood and carrying it home from the woods, one or two miles away; (*b*) gathering bait, sand eels and lobworms, in the estuary of the river, and carrying same home, weight about a cwt., over three miles; (*c*) meeting boats at the pier, carrying home fish, and helping to box and dispatch them by rail; (*d*) baiting the lines for next morning's fishing, an operation taking upwards of two hours; (*e*) hawking fish in the country districts.

"In the morning when the mother is away the children are left alone in bed. During the day when the mother is away they are looked after, those under school age, by the oldest girl of the family or by a neighbouring girl between 14 and 15 years of age.

"**Food.**—The usual dietary consists of tea and bread and jam or margarine for breakfast, a supper of the same, and dinner of some form of tinned meat and potatoes.

"**Maternity.**—The fishwife of this village carries on her normal work till about ten days before confinement, and then gives up the more laborious part. She generally lies up for ten days afterwards. I can find no evidence that this heavy work, more especially carrying such loads on their backs, has any adverse influence on childbearing, as one would be inclined to expect. The families are larger than the average for the county, or rather the women give birth to more children. Abnormal confinements are exceptional, and instrumental interference not common."

Shetland: Island of Unst

"Very few houses have any sanitary conveniences. There are no trained midwives in the district, but there are four very capable women who attend most of the confinements, the doctor being called in when labour seems, for some reason unknown to the midwife, to be unduly prolonged. Generally speaking, if labour has gone on for eight or ten hours without visible result, the doctor is summoned. The doctor attends rather less than a quarter of the total number of confinements.

"It is interesting to note that in the crofting districts, which include the whole island except Baltasound, labour is, as a rule, quite normal; while in Baltasound, in almost every case where the woman belongs to and has been brought up in that district, and where the mother's work is usually confined to household duties, knitting, and other sedentary occupation, some skilled assistance is nearly always required to effect delivery. Inertia of the uterus seems to be the usual difficulty.

"This would seem to indicate that outdoor work on a farm is directly conducive to quick, easy labour; while indoor life, and trying to dress up to fashion plate standard, has the directly opposite effect. Women, as a rule, follow their ordinary occupation until pains of labour compel them to give in. One woman died immediately after childbirth in 1915. No doctor was in attendance at the confinement. The cause of death was heart disease.

"One mild case of puerperal fever has been the record for eighteen years' practice, and it is not improbable that this was conveyed by the trained midwife who was stationed in the district when I first came. Certainly not long before my coming here, she had lost a patient with puerperal fever, and her ideas of cleanliness left much to be desired."

There is a vivid description of a doctor's life in these islands, the long distances to be traversed in all weathers by motor-bicycle and motor-boat. Dr. H. P. Taylor says in twenty-six and a half years he has conducted 1,000 midwifery cases, normal and abnormal, and is proud to say he has never lost a single case, although he had to nurse one case of peritonitis himself. She

recovered. He says, "Prior to any doctor being stationed in these islands, mothers reared families numbering ten to fourteen children, all assisted by local 'skilful women.' The mothers came round all right, the children lived, and are now fathers and mothers of large families themselves." One old wife, aged 87, the mother of eleven children, told him, "I never had a doctor. The wife who came to me from Unst used to bring a Testament and a razor with her. The razor she placed under my pillow for luck, and she used to read a chapter out of the Testament now and then to keep up my spirits."

"How these women lived without doctors, trained nurses, and antiseptics is a matter upon which you will form your own opinion. Mine is that childbearing is the most natural process in nature, and the less one interferes with the powers of nature, provided no mechanical obstacle exists, the better. My own practice is to do as little as possible when everything is normal."

Another Extract.—"Children's teeth seem to decay early, quite a contrast from former times. While it is rare to find a child of school age with a good set of teeth, it is quite the rule to see old men and women with almost perfect sets. In connection with this, it will be noted that the old folk were brought up first on their mothers' milk and later on the produce of their land, home-grown oats ground into meal in the hand-mills, plenty of milk, and fresh fish. Now there is far too much fine, clean oatmeal and wheat flour used, too much tea.

"Rickets is seldom seen; I do not know of a case in a child under school age. There are no idiots or imbeciles under 14 years in this district.

"As mentioned before, a woman usually goes about her ordinary work up to the time of her confinement. At the first signs of labour coming on, the midwife is sent for post-haste; if she lives any distance from the patient a vehicle, either horse and trap or motor, is requisitioned. The patient goes to bed and remains there till, at the earliest, the 'ninth day.' The midwife arrives and stays at least until labour is completed, no matter how many hours or days (in cases of false alarm) that may be.

"Formerly it used to be thought dangerous to wash the patient at all after childbirth, any old pieces of cloth were thought to be

good enough to use for absorbing discharges, and I often wonder how the poor women ever got well again."

Open-air Dwellers.—I observe that all open-air dwellers, especially all gipsies and wandering tribes, have but little trouble in childbirth. They are noted for their good physique, perfect teeth, and absence of such diseases as tuberculosis and appendicitis; tonsils and adenoids are unknown among them, and no tribe would stop its march because a woman was having a child. Yet these people are of widely different races—contrast the Arab woman one used to see on the Sinai peninsula with the women of the North-West Frontier tribes, as the Afridis and Zakka Khels, again the Powindah women, one of whom I distinctly remember coming to a Peshawar hospital from many miles away, carrying twin boys about three months old, one in each arm; or the Gujar women, with their picturesque clothing and plaited hair, encountered among the Kashmir hills, feeding their flocks on the fresh pastures just below the snowy line or carrying three pots of butter on their heads one above the other with swift and certain step along the mountain footpaths.

Then at home we have the Scottish tinkers, the English gipsies, and the boatwomen of our canals, all with large families and easy confinements. There is one manner of life common to all of them in which open air, hard work, and plain fresh food play their necessary parts, and produce the same results in people of such widely different stock.

The rapidity and ease with which little tinkers appear in the world rather shocks our Scottish reporter (Carnegie Report, p. 510). He says:

Tinker Confinements. — "Reference may appropriately be made to the occurrence of confinements amongst the itinerant tinker tribe. These people are shrewd enough in view of an expected confinement to pitch their tents in the neighbourhood of a town or village where medical aid can be summoned, but labour is conducted often almost in sight of the passing public, and, at the best, under the most hampering conditions. The infants not infrequently succumb to exposure. The license accorded to the class to make no provision for maternity claims ought, in the interests

of decency and humanity, to be converted into a penal misdemeanour."

He quotes the following cases:

(1) A solitary tent at the roadside; market stance, 1½ miles away; message to the doctor. Found the whole establishment patent to public gaze. A blanket was hurriedly fixed to two pieces of branch to act as a screen. Parturient woman lying on a pallet of rags. No warm water available. Labour normal; infant born. They remained for two days and then disappeared.

(2) Tent on same ground, but more removed from the highway; same conditions; a dead fœtus delivered. Disappearance of the parties on following day.

(3) Doctor summoned; 9 miles. Found a tinker woman lying on a bundle of straw in an outhouse of a one-time little inn; child already born. The doctor bundled mother and child into his car and conveyed them to a room provided by the Inspector of Poor.

(4) Telephone message; 3 miles away. *On arrival doctor found baby born at the back of the boundary wall.* Mother covered by a few shawls. A woman was sent out and the mother and infant were transferred to the Parish Council room.

These are quite recent cases.

Again we read: "The Caithness tinkers live in tents or caves and are prone to tuberculosis when they take to town life, but otherwise it is unknown among them when leading their natural outdoor life. The children were strong and robust." In many districts the report notes that "the midwifery results are good, but the health of the children suffers from the modern bottle feeding, the jam and tinned foods which were unknown to their mothers. Also their health declines *when they go to school!*" (Italics mine.)

Dr. Mary de Garis, of Geelong, Australia, published fourteen cases of painless labour in white women living in Australia (*British Medical Journal*, October 27, 1928). Most of them were country women, but she has had several in city women also. (We are not told how long they had lived in the city.) The following are examples:

"In this case Dr. Joyce was sitting reading, and the patient said in a perfectly natural voice that something was coming, and birth followed immediately. She admitted a slight pain or two."

Case 10.—Dr. Agnes Bennett's cases, New Zealand: "A primipara, who was a rather small-framed woman, suddenly woke with feeling 'water' coming away; she jumped up and threw herself on her knees just as the child emerged."

Case 11.—"The patient awoke in the night to find the birth occurring. While her husband was telephoning for the doctor the child was born in the bed."

Dr. Giommi (New South Wales) reports seven cases of painless labour in twenty-six years of Australian practice. All were strong, healthy, hard-working women. He considered the painless cases normal in every respect. He also has records of cases of the kind which occurred in Naples.

Case 7.—Aged 27, was living in a tent. The womb was seen to be contracting well, though there was no sign of pain, and the fœtal head appeared at the vulva painlessly. The placenta followed in ten minutes without pain, and the womb became well contracted. She got up the next day and did her work as usual.

Kashmir.—The problem of death so often accompanying motherhood was thrust upon my consideration in an acute form when I was in charge of the Kashmir Zenana Hospital.

The hospital was on the banks of the river Jhelum in the city of Srinagar, and in addition to cases attended in their homes by the hospital-trained midwives, women were often brought from long distances by boat to our landing-stage, or by cart to our doors, or were carried for miles on the ordinary string bed of the country by four men, or they would come walking painfully and slowly with groans and lamentations, supported by the mother and friends, having tried every possible remedy known to them to effect delivery at home. Others again were brought in a little covered swinging cot like a birdcage slung from a pole, carried on the shoulders of two men. But the worst cases of all had a rope attached to the bed on which they lay. That meant a very serious case and that the relations had given up hope, for the rope was meant to bind the corpse on the bed when taking it away again for burial. Almost every patient who came for relief in childbirth was already in labour and had been so for many hours stretching into days—the membranes ruptured, patient exhausted, and the unborn child often dead.

In the villages every effort would be made to effect delivery. The mothers consult, the village midwives are called in one after the other; each prescribes some new remedy usually strange to European ideas, such as clay pellets (of a special clay) pushed into the vagina. On one such occasion a husband reported that, in desperation, he had on the second or third day of his wife's labour gone out to the cross-roads to ask counsel of a stranger (often done in the East, to ensure that the advice given will be disinterested). A man with a gun who had been out after game came by. The villager laid his wife's condition before him and asked his opinion. The hunter offered to accompany him to the house, as he was sure that he knew how to cure the patient. He was taken into the sick woman's room unknown to her, and discharged his gun behind her head. The effect was magical—the fright renewed her pains and all was safely accomplished. But too often no such simple measure will avail. The little mother would arrive at hospital after being repeatedly examined at home by Kashmiri midwives and friends, as the swollen and gangrenous skin bore witness, and in a great number of cases the infant's head was still well above the brim, and there seemed no possibility of its ever engaging in the pelvis, much less of being born.

No one could see such suffering unmoved, and without desiring to find the cause. The women were mostly young, some mere children themselves (fourteen and sixteen were ordinary ages for motherhood), and the days of torture undergone at home while traditional remedies were tried must have seemed interminable. The native midwives employ hollyhock root, fowls' intestine made into balls, quince seeds tied up in a bit of filthy rag torn from the midwife's clothing and pushed into the vagina, and, besides these time-honoured medicaments, physical violence is often resorted to, such as pressure on the eyeballs and on the abdomen of the patient. Their bodies often bore marks of the midwives' feet. And from the presence of these bruises and of patches of gangrenous and sloughing skin round the vulva and anus, we judged of the difficulty and severity of the delivery, the history being almost always unobtainable and worthless.

To die in childbirth in the East is to die in most terrible torture. Many of these women the hospital was able to save, but a number came to us in such a condition (for in the East a woman in labour

must not take food or sleep and is forcibly kept awake, sometimes by the beating of a drum) that they died of exhaustion or from sepsis caused by the treatment at home. And it was not as if the mother gave her life for her child. Many of them were only too willing to do so, but a child whose mother dies in giving it birth is looked upon as bringing bad luck to the household, and so even if born alive it is often neglected until it dies. In one year out of only one hundred and twenty deliveries in the Zenana Hospital there were twenty-nine Cæsarean sections, performed because the pelvis was grossly deformed and the woman already in labour. Of the rest only one was a normal case. This gives an idea of the hesitation shown in the East to seek for outside advice in childbirth until the case is desperate.

At first one had the idea that every woman in Kashmir had difficulty in childbirth, as most of those we saw were *in extremis*, but I soon realized that we saw very few women out of those in the whole country, and only those parturients who were already in difficulties. The majority of the women delivered themselves at home with little trouble, perhaps with the aid of mother or friend or the village midwife. In reply to advice given by us to out-patients that they should come to us for the confinement, they would say, "Yes, truly I am an omed-walli" (a woman full of hope)—their expression for pregnancy; "but the place for a son to be born is in his father's house, not in the house of sickness among strangers."

We soon became aware of a curious fact about these patients, for it was noticeable that the women who needed our aid because they had such desperate trouble in childbearing were invariably of the better class, the richer and higher caste, the women kept in close seclusion, often living in one small dark room; those who wore shoes, perhaps ate white bread, and cooked all their food, even fruit, which they think is unwholesome if eaten raw. Most of us know by hearsay that in the East the women of the upper classes live in seclusion, but we can have no idea what that custom entails unless one has visited them in their houses. Special apartments, or it may be only a room or perhaps even only one corner of a room (before which a curtain is hung if the family be poor), are provided for them, and they never go out or see any man but their husband or brothers. Even a casual observer can see that

this state of things produces much sickness, and also renders it difficult for a woman who is ill to obtain efficient medical aid, as the visits of a man doctor would be out of the question, and it is especially difficult for her to get medical relief in case of difficult childbirth when, according to Indian custom, she is unclean, and can only be touched by those of the lowest and *dirtiest* caste, the hereditary midwife, whose lore is traditional.

Indian ideas render it necessary for a respectable girl to begin her seclusion from men even before puberty, and she is then kept in close confinement and may not go out of doors for fear of being seen.

She may be married at, or soon after, her *own* birth, although the usual time for her to go to her husband's house is as soon as she attains puberty. (In common practice one finds children of 10 or 12 living with husbands.) As a young married woman, her seclusion is even stricter than at home—she is kept in the women's apartments with the other married and unmarried women of her husband's family. In towns the rooms for women are usually dark and airless, because in order to secure privacy their only outlook is into the inner courtyard, a dull and often very dirty, cheerless spot—with the family refuse and manure heap occupying one side.

In Kashmir girls of 8 were kept indoors for fear they might be seen by strangers and perhaps kidnapped. A respectable woman told me that her own mother heated the tongs and burnt her feet at 8 years old, saying, "That will teach you not to go out and play in the street with boys"; so that during those important years of growth—8 to 14—when the girl should be well-nourished and have light and air and be at play, she is condemned to an indoor life, and in consequence she becomes pale and thin; she complains of backache and pains in the limbs, her hair falls out, her teeth begin to decay, her digestion suffers, the tongue is furred, and she grows up stunted, and in many cases deformed first by rickets and later by osteomalacia. The results are seen in softening of the bones, which leads to such deformity of the legs, arms, and pelvis more particularly, that parturition when the time comes is all but impossible, and the infant, if born alive, usually dies of its injuries soon after birth. Fractures of the affected bones are common. For this reason many high-class

Indian households who observe purdah *are without heirs*, even though there are several wives to provide them.

The enormous amount of preventable sickness caused by this confined life can only be alluded to here, but anæmia, rickets, osteomalacia, tuberculosis, acute dyspepsia, dental caries, and pyorrhœa are common complaints among purdah women, and the effect on the community of such insanitary living is devastating (because the purdah system renders these houses immune from the prying eyes of any sanitary inspector); and when epidemics of malarial fever, plague, cholera, and smallpox sweep away half the population, the breeding place of the mosquito, flea, and cholera germ cannot be disturbed or interfered with on account of the inviolable privacy of the women's quarters. Thus we have the spectacle in India of health officials conducting health campaigns in a city and removing filth from the public streets, while the women's quarters of every house in the same area may be centres of every insanitary practice; unremoved sewage lies about, flies breed on garbage heaps, windows are closed on tuberculous patients, cholera-soiled clothing is washed beside the well from which drinking water is obtained, mosquitoes breed in the stagnant water used for washing or cooking which has been thrown out on the ground in the yard. In many places garbage pails are unknown, as is the simple idea of burning refuse. Human excrement is deposited and lies on the highway and in the private yards. A man goes outside and uses the street for sanitary purposes; the women of the better class must not do this. Is it any wonder that reputable insurance companies refuse to insure the lives of women living in purdah? Do not suppose from this that Indians who can observe their own religious and sanitary laws are unclean, far from it. In many ways they are more cleanly than we are. To give one example—a man does not touch a drinking vessel with his mouth, and the idea of all and sundry using the same cups and plates, as in a restaurant, is most revolting to him, whether he be rich or poor. As to childbirth? It is considered a natural event, but an unclean process. It is among these secluded women that the most difficult cases occur, and if there is trouble and the indigenous midwife cannot cope with it, the patient may linger in agony for days; but some effort is always made at the last to deliver her, because

a woman dying undelivered is believed to haunt the house. In illustration of this, I was travelling and had stopped at a lonely mission house in the Simla hills. My bearer came to me in the morning and said that he and the syce had been unable to sleep because of a ghost. I asked what kind. And he sadly replied that it was the ghost of a woman who had died in childbirth. Knowing he was a stranger to the place, I said, "How *could* you know that?" and he said quite simply, "She walked with her feet turned backwards, so you may always know that kind of spirit, and it's a very bad sort."

But who were those women in Kashmir who never had trouble in childbirth? They were the outdoor women such as the field workers, doing most laborious work, and the boat-women of the Mangi class, of whom the Mission Doctor (Dr. Ernest Neve), after thirty years' experience in Kashmir, says he never remembers one coming to hospital for her confinement. These people are born, live, and die on the big rice boats, which have a small hut at one end for the family while the larger part is occupied by the cargo of rice they bring from the fields into the city. This city is Srinagar, the City of the Sun, a town of some 30,000 inhabitants intersected with water-ways rather than streets. These boat people have never lived in houses since the Flood, they will tell you, and further claim descent from Noah. They are a fine, hardy, well-grown, intelligent, hard-working race. With the exception of dwellers in tents, no people on this earth live a healthier life. The women wear but one garment even in winter, although the temperature often falls below zero, and they engage in all the hard work of the boat, and may also be seen milking their goat or cow (carried on board, of course), collecting their cocks and hens, and husking the rice with a long heavy pestle in a wooden mortar on the banks of the Jhelum river. Graceful, healthy, cheerful people, their smiling faces showing perfect teeth. And their food is of the simplest and cheapest, for fifteen shillings a month is not much on which to keep a wife and family. They have milk, eggs, and an occasional chicken or duck, but the main food is rice husked by hand and curried vegetables, such as tomatoes, cabbage, turnips, and potatoes, all cooked in mustard oil extracted by a wooden press from the seeds grown in those fields of golden yellow we know

so well as a feature of the Kashmir landscape in spring. The mother, of course, nurses her offspring one by one, and if her milk fails the child usually dies. No patent foods are used here, but perfect teeth, good bodily development, and *intelligence* are the rule. They get no education but what they pick up for themselves, but given a chance they would equal the best brains in the State. There are no feeble-minded among them, for they would soon fall overboard and be drowned. They are in no hurry to marry off their daughters, because they would lose their services just when they are beginning to pull their weight in the family boat—so, unlike the purdah women, they are mature before marriage.

And then there were the country women, hardy and healthy, working in the ricefields, knee-deep in cold water, their scanty clothing tucked up well above the knees, planting out the young rice plants in spring. They came to our Out-Patient Department for one trouble or another—indigestion, rheumatism, or to bring children with minor ailments such as worms or scabies—and in reply to an enquiry they would tell us they had had a number of children born with no trouble at all, and the last idea that would occur to any of them would be to go to a hospital for such a natural and ordinary event as having a baby, an event common to every woman of their acquaintance.

More instructive still as showing that easy childbirth does not depend on race but upon environment and the *conditions in which the mother spent her childhood* is shown by the case of the women of the Julai or weaver caste in Bombay. Dr. Turner Watts of the Cama Hospital tells me that whenever a woman of this caste came in for confinement, the doctors anticipated an abnormal labour and her pelvic measurements were at once carefully noted, as these women always had a bad time, and usually required Cæsarean section. So difficult were their confinements, that she assured me that were it not for the influx of healthy women from their villages outside Bombay the caste would die out. In these villages, where the women go out freely and have plenty of sunlight, they have no difficulty in childbirth, but in the city these women have to live in "chawls"—blocks of buildings of eight or ten storeys high—which effectually cut off the sunlight from the ground-floor rooms, and *in these lower rooms* their husbands work

because the loom has to be on the ground floor near the window, and the women live behind the loom in semi-darkness. This is a most striking example of the effect of town life and industrial conditions on childbearing. In strong contrast to these people there also lives in Bombay an advanced and most progressive community, the Parsees, whose girl children go out to school and whose women are free and well educated. It is a rich community and they are able to live in large airy houses. There is no idea of purdah or seclusion and in the Parsee Lying-in Hospital Dr. Nariman, himself a Parsee, reports that out of 25,000 deliveries no case of osteomalacia has ever been seen, and out of 17,000 deliveries only two of his patients required Cæsarean section. Rickets exists but is not common among them, and marriage does not take place until the girl is 20 or 25. What a contrast to the other merchant communities in India as the Marwaris who are Hindus and the Bohras who are Mohammedans, but both keep their women in close seclusion. In Calcutta Professor N. Pan, Professor of Anatomy in the Medical College, writes to me that "osteomalacia is chiefly confined to Marwari women." He says, "I think you have seen these women and watched their mode of life. They live in huge blocks from which sunlight is completely excluded. . . . Among the Marwaris there is a rigid purdah system and exclusion of sunlight as well." He goes on to say that in the Marwari Lying-in Hospital osteomalacia is very common, necessitating Cæsarean section and causing every kind of abnormal and difficult labour, and he explains that although the purdah system is also rigid among the Mohammedans in Calcutta, they live in huts "*well exposed to the sun*" and so do not suffer in the same way as the Hindu women do. He adds, "You are right in your conclusion that in the villages the pelves are well developed. In towns, difficult labour, deformed pelves, and osteomalacia are more common. In a village where I passed my early days difficult labour was rare. Full-term pregnant women of the working classes often go for outdoor work and come back with babies after easy labour."

All over India we find that those able to secure strict seclusion for their women are the ones where difficult labour is common. These people therefore furnish most of the cases of Cæsarean

section to the hospitals, whilst the sweeper and scavenger caste and the tea garden coolie women who go about freely in the air and sunlight and work hard, have easy and safe confinements.

That some Indians recognize this fact for themselves is shown by the following, quoted from Malcolm Darling, I.C.S. In his book, "Rusticus Loquitur," p. 14, he speaks of a Pathan in the Punjab who told him that although his own family keeps purdah he is himself opposed to the custom. "It is bad for health," he said. . . . "As women grind and spin much less they get no exercise. This affects them in childbirth. A woman who works in the fields suffers very little, but the purdah lady is laid up for some time."

Read Exodus i. 15, how the Hebrew midwives were ordered by Pharaoh to destroy the boy babies at birth, and their reply that the Hebrew women had such quick labours that it was all over before they arrived on the scene. Note also as ever—the nomads —the Hebrews, the dwellers in tents, had the easier and quicker confinements compared with the more civilized Egyptian women (who, judging by a specimen in the College of Surgeons, had the oval pelvis). One would expect to find this in the skeleton of a mummy, for it was only the rich and luxurious (who sat on chairs in their lifetime) who could afford to be mummified after death.

From America comes an interesting corroboration of the pernicious effect of indoor and city life on the race which, living in its natural surroundings, accomplishes parturition safely and with but little inconvenience to the mother. I refer to the negro of the large cities such as New York and Baltimore. Dr. Whitridge Williams, of Baltimore, says of the negress, "Were it not for the greater compressibility of the negro infant's head there would be more Cæsarean sections necessary among them for deformed pelvis than among any other class of the community." And again, "The city negro suffers acutely both from bad teeth and rickets." Yet the negress living in her kraal in Africa and leading a hard-working life has perfect teeth and rickets is unknown. "She does field work, the cooking and grinding of mealies, she brings in wood, fetches water, and bears her children with no difficulty: she kneels on the ground, bends her body forward, and the birth is accomplished" ("The Uganda Protectorate," Sir Harry Johnson).

Again in China the women who have such difficult confinements necessitating Cæsarean section are those who bind the feet, and consequently live indoors, as they can only hobble about. The worst cases come from the districts where it is very cold and they must live indoors sitting on a warm brick platform called the "kang." The only case of a male person known to have had osteomalacia and who showed the characteristic softening of the bones of legs and pelvis was a boy, similarly confined to the house for one year on account of illness. (Reported by Drs. Maxwell, Miles, and Feng.)

A missionary doctor writes to me from Ladakh, where there is no purdah and the women engage freely in field work. "Not much use your coming here to study midwifery conditions—they hardly ever send for the doctor, they manage it all themselves and are never really bad cases needing skilled interference."

An account of childbirth in "A Thibetan on Thibet," by G. A. Combe, is to the point. "The Thibetan woman is fortunate above others, accomplishing her childbirth easily. She may go to the mountain for wood and bring back a child in her gown. But she does not like anyone to know the time when she is to give birth, for if a neighbour knows, the birth will be delayed for an hour; if two persons know, it is delayed for two hours; if many persons know, the delivery will be very difficult—being delayed perhaps five, six, or seven days.

"There is no period of seclusion, and ordinarily the mother is at work again next day. In Thibetan houses the ground-floor is a stable for yak, sheep, and other animals; the family lives on the first storey; the flat roof is used in praying to the good and evil spirits. It is bad to be delivered on the roof in the open air, childbirth is easiest close to the earth, so the expectant mother goes to the stable, which has no wooden floor and which, besides, is the most private part of the house: also there may be an idea that delivery among the cattle will be as easy as that of the cattle themselves. There is no doctor, of course; if the woman is rich she will take a servant with her, if poor she goes alone.

"The babe is born on a rug or felt, richer people using a hair mattress. It is not washed, merely wiped, and a little butter is put on the fontanelle in the belief that it will strengthen that part of the cranium. For the first three days it is wrapped not in new

clothes but in the undergarments of its parents, which are soft, and have implicit in them the warm affection of father and mother. The afterbirth, which is thrown away, is called colloquially in Dartsendo "Birth Friend" (*Zyerog*). On the third day the Lama is brought in to give power (*tse-wang*) and baptize the child. As already noted, the child bears no relation to its parents, so surnames do not exist."

In Thibet there is no purdah or seclusion of women. Teeth perfect, rickets unknown.

Bertram Thomas, in "Arabia Felix," says of the women of a tribe of mountain men in the Gara Mountains: "She works up to one day before the birth and bears under a tree or in the open or in a cave . . . and she is fit for work the next day."

The Maoris.—Dr. Violet Hastings, of Auckland, New Zealand, calls my attention to a book, "The Maori," by Elsdon Best, in which he says: "In the matter of giving birth to a child the Maori was remarkably free from suffering and the ills experienced by women among more civilized folk. I have known women on the march, or engaged in some tasks, go aside for an hour or so and return with the child. In parturition the native woman kneels down with the knees well apart. . . ." Hori Rapiha, of Waipawa, in 1893, wrote to Mr. Best: "Women of the Maori folk did not die in childbirth (formerly); although a native woman might give birth to many children, yet she would not in any case die. Maori women were of a fine type, robust and healthy, and wise in matters pertaining to childbirth; they did not succumb. In these times many native women die (in childbirth); the women who so die in a single year may perchance amount to 100 or even as many as 200!" He thinks this is due to the adoption of European medicines, food, and clothing. This remark is of interest. "Some very singular traditions are retained by the Maoris in regard to the Cæsarean operation having been performed in former times, but such are always located in some far-distant land, inhabited by primitive people who are often unacquainted with fire, or if localized are relegated to times long passed away."

With regard to the teeth he says: "Dr. Scott also notes the fact that the teeth in skulls examined by him had the whole crowns ground away, but that he never detected any signs of

dental caries. The present writer has noted the same peculiarity in many old native skulls seen in caves and hollow trees, where they had been deposited after the exhumation of the tribal dead. Judging from the teeth seen in many hundreds of old skulls the Maori should not have suffered much from toothache in olden times."

In 1814, the Rev. S. Marsden wrote as follows of a (Maori) woman he saw "lying with a child about three days old by her side in the open air, sheltered only by a few reeds placed in the direction from which the storm of wind and rain blew. In fine weather no shed at all may be erected, the woman giving birth to her child in the open. Among native women, giving birth is by no means the ordeal it is to European women. It is surprising to white people to note how little fuss the former makes over the matter, how little it affects them in regard to the performance of their various labours. I have seen a woman go aside into the bush, alone, and shortly after return with the new-born child, washed and wrapped up in one of her garments.

"A woman here went into the bush one day to procure firewood and returned with a large bundle of the same slung on her back. She walked into camp and squatted down that she might slip her arms from the straps and so get rid of her burden. As she did so her child was born. But she never turned a hair. Quickly undoing some hidden tie or button, she allowed one of her garments to slip down and cover the child, thus saving the situation beautifully. A native woman never lies down when in labour and cannot understand why a white woman should do so; she says that it is a most inconvenient and unnatural attitude to assume at such a time.

"After parturition a woman often betakes herself to a river or stream and immerses her body therein, lying on her back. The death of a woman in childbirth is spoken of as an almost unknown occurrence.

"Children from 6 to 12 years used to run about naked and their teeth were perfect. Now the teeth begin to decay, the race suffers from consumption, and there is also trouble in childbirth." Mr. Best notices how much more robust the older generation are.

The same authority states that he has observed that the older

natives are by far the most robust, much more so than the younger people and children, and also that the natives of the Tuhoe tribe say that their women have more trouble in menstruation than they had formerly, difficult and painful menstruation being very rare in old days, a fact which Mr. Best thought might be connected with the increasing lack of fecundity so noticeable among these tribes.

Dr. Hastings adds: "As to the custom of squatting instead of using seats, a Maori guide at Whakarewarewa, Rotorua, recently stated that squatting was common only amongst the old people. This was certainly true of a nearby group, the elderly grey-haired women squatting on the ground, while the younger people were seated. However, this relates to the habits of a comparatively few Maoris on the outskirts of a town and may not be true of the race as a whole."

With only our present-day conditions to judge from, it is difficult to imagine that there may have been, at some time, races in which childbirth was a normal process. For it is difficult not to agree with what Joseph De Lee writes in the introduction to his work on obstetrics: "Is labour in the woman of to-day a normal function? I say it should be, but it is not. Can a function so perilous that, in spite of the best care, it kills thousands of women every year, that leaves a quarter of the women more or less invalided, and the majority with permanent anatomic changes of structure, that is always attended by severe pain and tearing of tissues, and that kills 3 to 5 per cent. of children—can such a function be called normal?"

A reference to the animal world is of interest. Wooldridge, in *Veterinary Science and Obstetrics*, p. 157, vol. 2, tells us, as regards trouble in parturition, the chief sufferers are dairy cows which are tied up, while cows which enjoy plenty of freedom and a natural life in the open are less often affected. It is common knowledge that the Pekingese and all lap dogs suffer in the same way from *an unnatural life*, which is now the portion of most civilized human beings.

We see, then, from this preliminary survey, that easy and difficult childbearing may be found side by side in the same countries, in the same races, and even in the same families, that easy childbirth characterizes those living an outdoor life while

difficulty is the portion of those living indoors from infancy, confined there by social or educational tyranny.

The conditions seen in India, where the rich merchants' wives are the sufferers while the country women living in the open air have their children easily, is paralleled by a recent Government Report, which states that difficult childbirth in England, with its concomitant of stillbirths and neo-natal deaths, characterizes "the better off" in a district.

CHAPTER II

CAUSE OF DIFFICULT CHILDBIRTH

THE causes of difficult labour have always been matter for speculation. Primitive people think it is due to the child making no effort to leave the mother's body and so they use charms to coax it to come out.

Hippocrates speaks of faulty presentation of the child as a cause of difficult labour, while Aristotle noticed that the women who suffered during parturition were those who led a sedentary life, and so he thought it was due to the thorax being imperfectly developed which prevented them from holding their breath to strain. Cleophantus put the blame on narrow hips, while Herophilus considered the use of the obstetric chair made birth more difficult than it was when the natural posture was adopted. Soranus taught that either the child was too big or the fault lay in the mother, who was too fat or whose pelvis was too small. He had observed that most children in the Rome of those days suffered from rickets (as we shall see later the outstanding cause of difficult labour to-day). The Chinese blame the mode of life as they state that the peasant women bear easily, but are agreed that a sedentary life is bad for women, and say that, if they can, pregnant women will always refrain from work of any kind.

The first sign of difficulty in labour is its undue prolongation. What then is the normal duration of labour? Some interesting figures were published by Hrdlicka, Bureau of American Ethnology, 1908.

Out of 35 cases observed in American Indian women, 7 took place within one hour, 11 under two hours, 3 in two to three hours. In 25 per cent. labour lasted two hours or less; in 32 per cent. labour lasted seven to twelve hours; in 17·6 per cent. only was the labour prolonged and lasted more than one day. The placenta in all but two cases out of the 35 was delivered within half an hour of the birth.

Compare these figures with confinements in England and America. Herman, "Difficult Labour," states that a first labour

is normal if completed in twenty-four hours. Then consider those cases where labour continues off and on for several days, the mother is bruised and exhausted before the end, and the child suffers from the difficult passage it has just made, and from the worn-out state of the mother, who has little energy left to undertake breast feeding after all she has gone through.

Then what is the nature of this difficulty in parturition? Is it a case of misfit? We recall Soranus' teaching and ask: Is the child's head too big, or is the maternal pelvis too small? An answer to this question must be found, for delayed and difficult childbirth is the result of misfit, as is the bruising and tearing of soft parts, the exhaustion of the mother, the risk of sepsis and of puerperal fever, all conditions directly due to this primary failure of adaptation between mother and child which lengthens out the natural process of birth into many hours, or even days.

Is the child proportional to its mother? Shenton and Horowitz say, "What really matters is not the absolute but relative measurements of fœtal head and maternal pelvis."

In India, Leicester and Lane, with a view to the solution of this problem, conducted a series of observations at the Eden Hospital, Calcutta, to determine what influence the mother had upon the size of her infant, and they came to the conclusion that the size of her infant and of the fœtal head was in every case determined by the mother herself, and was proportional *to the size of her pelvis*, for the English mothers had the largest pelves and infants with the largest heads; the Indian mothers had the smallest pelves and gave birth to babies with the smallest heads; while it was found that the women of mixed race, the Eurasians, had children intermediate in size. They further noted that the white or pale Eurasian mother was of stouter build and had the larger children, while the dark Eurasian was smaller and slighter and produced smaller children.

The inference was drawn, therefore, that the mother's pelvis determines the size of her child's head. An interesting conclusion, for it thus appears that the mother's pelvic capacity is the mould of the racial head.

We see the same thing in the animal kingdom: the hen determines the size of the egg she lays, and in mules where size and strength are needed the mare is chosen for the maternal parent.

It is well known that if the ass is the mother the offspring will be small and of no value. The jennet, as it is called, was specially bred in the Middle Ages as a small and economical steed much used by the monks and nuns.

But no doubt a good margin of useful space is always available in all normal human pelves, for Whitridge Williams tells us that in America, "provided the pelvis be normal, it is unusual for children weighing less than eleven pounds to cause difficult labour simply from their size," and Fitzgibbon, of the Rotunda Hos-

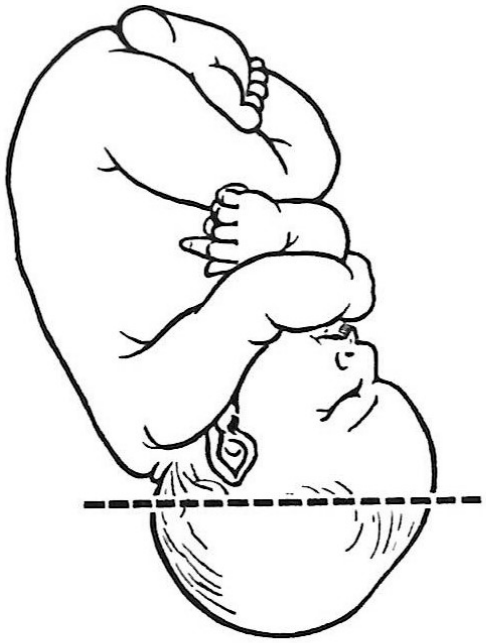

FIG. 1.—THE SUBOCCIPITO-BREGMATIC DIAMETER OF THE HEAD.

pital, gives it as his opinion that in 75 per cent. of cases where the mother has only a medium or contracted pelvis, she will deliver herself if time is given for the head to mould. Varnier, too, found that the diameters of the fœtal head do not increase in the same ratio as the body weight *in utero*, so that a heavy child does not necessarily give rise to a difficult birth.

The size of the child can be controlled by diet and perhaps more surely by exercise. No child should weigh more than seven or eight pounds at birth.

Among all nations there are traditional diets for the pregnant woman whose object is to ensure an easy delivery.

In the hope of getting some light on the problem of difficult childbirth from the anatomical standpoint I consulted Sir Arthur Keith, who told me he thought that undoubtedly the heads of the race were getting larger among civilized people, but the pelves of the race did not seem to keep pace with them, hence the increasing difficulty in childbirth. With his permission, therefore, I was allowed to examine and measure any specimens I wanted at the Royal College of Surgeons. This was in 1929.

It would seem that the question of birth reduced to its simplest form involves two factors:

1. The hard unyielding pelvic brim of the mother.
2. The soft yielding head of the child, which passes through the pelvis.

But if the mother's pelvis determines the size of her child's head, and that head is compressible as we know it to be, *then the fault must lie with the unyielding pelvis*, and first of all with the rigid brim into which the fœtal head must fit before it even begins its journey down the birth canal. Therefore I decided to concentrate my attention upon the pelvis, beginning with the brim. Surrounded by skeletons from all parts of the world, I soon became aware of the great variability in shape shown by this portion of the human frame, but especially was this variability of form noticeable in the female skeleton, and, contrary to received opinion, it does not possess a shape peculiar to one race distinguishing it from another, but *even in the same race* and the same family the shape of the pelvic brim varies widely *among all women*, perhaps more so than any other feature of their anatomy.

Verneau, in 1875, noted this peculiarity and, commenting on it, stated that the female pelvis was subject to such wide variation in form *even in the same race* that, in the end, he confined his observations almost entirely to the male pelvis among the different races of mankind, for though the pelvis of the male also exhibits variations, it is within much narrower limits. This variability of pelvic shape is shown when we make a comparison of obstetric text-books in this country. They are by no means of one mind as to what are normal pelvic measurements, and they also differ from those given by Continental observers.

Then another question arises: Is there any relationship between the size of the head and the size of the pelvis in the adult? The

condition known as acromegaly, in which both head and pelvis are enlarged, would suggest that cranial and pelvic development may in some way be related.

Large heads do not appear to be associated with large pelves and small heads with small pelves as one would expect, but it is noteworthy how the proportion of head to pelvis differs in male and female, the male having a large head and small pelvic brim, the female a large pelvis compared with her head circumference, as the following table will show.

Head measure taken round skull one inch below inion to the bregma, measure of inner circumference of pelvis taken with string, closely following the ilio-pectineal lines, across the back of the pubic symphysis and across the sacrum just below the promontory in order to keep in the plane of the brim.

SKELETONS

COLLEGE OF SURGEONS, LONDON

Race.	*Catalogue No.*	*Circumference Head.*	*Circumference Pelvic Brim.*	*Ratio Head to Brim.*
		cm.	cm.	
1. Frenchwoman	341.70	44·2	45·0	0·9
2. Englishwoman	70.1	44·5	45·4	0·9
3. Sikh woman...	631B	44·5	39·5	1·1
4. Bushwoman...	1300	42·6	34·0	1·5
5. Bushwoman...	1301	44·5	35·5	1·2
6. Andaman Islander	f. 1218	43·2	34·5	1·2
7. Andaman Islander	f. 1212	44·0	36·4	1·2
8. Andaman Islander	f. 1213	42·8	32·0	1·3
9. Aino female	847	44·8	40·2	1·1
10. Egyptian pre-dynastic female ...	583.01	45·0	40·3	1·1
11. Negress	1256.51	44·0	36·8	1·1
12. Englishman	336	47·2	37·5	1·2
13. Male	69	48·3	39·0	1·2
14. Male	68	51·0	38·5	1·3
15. Punjabi male	631A	47·5	42·0	1·1

There were too few female pelves and heads belonging to each other from which to draw very reliable conclusions, but what strikes the observer at once is that the measure of the woman's head is surprisingly little more than the inner measure of her own pelvic inlet. In the two examples afforded by the French and English woman it is less than her own pelvic brim measure, and the more highly civilized she becomes the less difference there is—

cf. Andamanese, Indian, with ancient Egyptian, French and English woman.

Testut ("Osteologie," vol. i., p. 336) notes that the pelvis enlarges as it passes from negro to European, and states that in all races the pelvis of woman is larger than that of man.

But it soon became apparent that what I was really in search of was not so much the shape as the capacity of each individual pelvis to hold and to transmit a child's head, and that the varying forms of the pelvic inlet only concerned me in so far as they increased or diminished the available space designed to accommodate the infant's head during birth, very much as one would regard different sized egg-cups and wonder if they were made to hold sparrow, chicken or goose eggs.

So that it was necessary to find out how much room there was in these pelves for the child's head.

The usual transverse, oblique and conjugate measurements did not give any information as to the total area contained by any one brim.

I tried to find this area by measuring the inner circumference with string and plotting it on paper: afterwards, in pinning this string out on paper to make a tracing, it was obvious that the same length of string arranged as a circle enclosed a larger area than the same boundary line arranged in any other form, and that circumferences being equal *the shape of the brim determines the capacity of the pelvis.*

One has only to take a flexible rubber ring such as a pessary, or the round rubber ring from the lid of a pickle jar, and one can see that as a circle it encloses a maximum area. As an oval (when the sides may be almost in contact) it encloses a much smaller space, so that the *shape* of the pelvic brim is more important than its circumference, as regards its capacity for the birth of young.

I then studied the variations in shape in a number of female pelves in different races and measured the transverse and antero-posterior diameters of the brim to get an idea of their variations from the circular form.

But in order to ascertain their individual capacity tracings were better, and I made 31, this time using a flexible lead ribbon carried round the pelvic brim just across the promontory, and

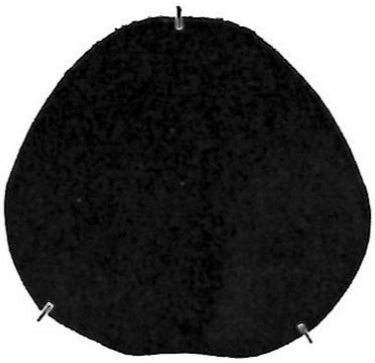

FIG. 2.—ENGLISH FEMALE, AGED 64. NO. 165.

FIG. 3.—ENGLISH FEMALE, AGED 27. NO. 160.

FIG. 4.—ENGLISH FEMALE. NO. 167.

FIG. 5.—ENGLISH FEMALE, AGED 55. NO. 164.

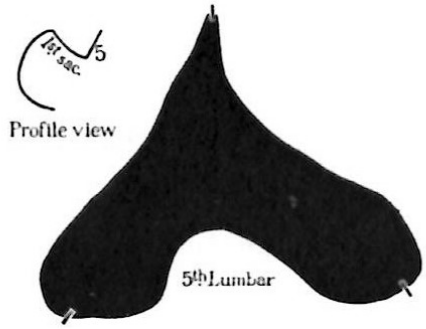

FIG. 6.—OSTEOMALACIA. NO. 560.

FIG. 7.—LAPP (?) WOMAN. NO. 559A.

FIG. 8.—TRIRADIATE RACHITIC PELVIS. NO. 559.

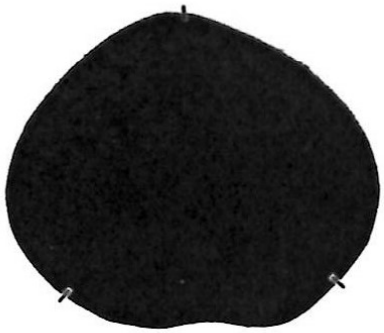

FIG. 9.—EGYPTIAN WOMAN. NO. 583.01.

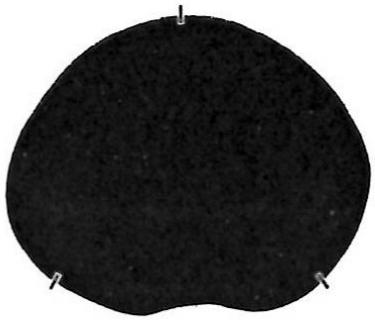

FIG. 10.—JAVAN WOMAN, AGED 25. NO. 921A.

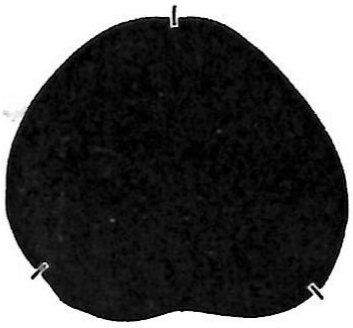

FIG. 11.—BUSHWOMAN, NOONA TRIBE. NO. 1300.16.

FIG. 12.—AUSTRALIAN ABORIGINAL WOMAN. NO. 1052.

FIG. 13.—ANDAMAN WOMAN. NO. 1218.

FIG. 14.—ANDAMAN WOMAN. NO. 1214.

FIG. 15.—ANDAMAN WOMAN. NO. 1213.

FIG. 16.—BUSHWOMAN, KOWA TRIBE. NO. 1300.14.

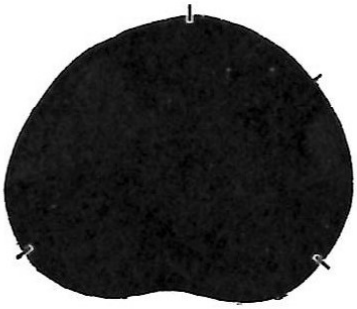

FIG. 17.—BHUTIA WOMAN. NO. 652.2.

marking the pubic symphysis and the sacro-iliac joints in each tracing to determine *where* the deviation from the circle occurred in the majority of pelves. Was it at the back or in front?

The European, Englishwoman, Frenchwoman and Russian pelves were flattened from before back, having the longest diameter transverse. (One type of the osteomalacic pelvis and the ape's pelvis is flattened from side to side, having the longest diameter antero-posterior.) Then I came upon some pelves whose inlet approached the circle, and finally the Andaman Island female specimens 1218, 1212, 1213, the Sikh woman 631 B, Peruvian f. 1013, South Australian f. 1068.15, and negress 1256.51, whose transverse and antero-posterior diameters are of equal length and consequently the pelvic inlet or brim is a perfect circle.

There are also some portions of pelves, notably one from Ur of the Chaldees, one from Salisbury Plain (Ancient British) and an Anglo-Saxon specimen, where we can see the roundness of the ilio-pectineal line, and are led to the conclusion that the more untouched by civilization and modern habits of life the more nearly circular the pelvis. All these people bore their children safely in primitive conditions with neither doctor nor skilled midwife.

Turner in 1866 called attention to the roundness of the pelvis among primitive people, but he thought it was "a degraded form."

Again, Professor Zaager, of Leyden, in 1866 classified pelves according to the relation between the antero-posterior and conjugate diameters, and considered all those as *round* where the proportions were as 100 to 90.

Fabre, the author of a popular obstetric text-book much used in France, describes three forms of normal pelvis, of which one is *the round*.

Then the question arose, Can there be any racial differences in the fœtal head to account for these great variations in pelvic form in the mother?

I do not think so, for it was at once apparent that the round-headed (brachycephalic) race, such as the Englishman, is born of the oval or long pelvis (with difficulty), while the long-headed race (dolichocephalic), such as the Bushman, is born of the round pelvis (with ease), so that the shape of the pelvis does *not* vary in

order to accommodate the varying shapes of the head in the human race, and therefore these pelvic variations serve no useful purpose.

But perhaps it might seem as if the moulding of the fœtal skull in the process of birth should enable it to make use of every part of the area contained by the brim whatever the shape, but that this is not so was proved by Lynch in America, who published X-ray studies of parturition, in which the infant's head is seen passing through an oval brim leaving the ends of the oval empty, and no amount of moulding will make it fit into this space, which is therefore wasted.

FIG. 18.

For the fœtal head is made to mould into a perfect circle and a *larger fœtal head can be born through a pelvis with a circular brim than through any other shape of inlet with the same boundary measure.*

Now if there is the slightest departure from the circular brim trouble follows with the fœtal head because the area available for its accommodation is lessened, even if only by a fraction of an inch.

But in the civilized European pelvis the head descends, during birth, in a screw-like manner because the three largest diameters of the pelvis are all in different planes, due to the fact that the pelvis itself is out of shape.

There should be no turning into transverse or oblique diameters.

At the beginning of labour in the round pelvis the child's back is to the front and central. The head, well flexed, descends with the occiput forward. Thus the sides of the head with the important motor and sensory areas of the fœtal brain are not pressed on in any way. The oblique positions indicate the oval brim.

The round pelvis provides accommodation for the biggest head which its circumference can enclose. All the diameters in all the three planes are equal (or speedily become so in labour with movable sacro-iliac joints), the sacrum swings back as on hinges; the ilio-sacral ligaments are flexible and elastic, as is the perineum, while the head is kept to the front by the natural posture of the mother (crouching) and birth is easy.

FIG. 19.—OVAL.

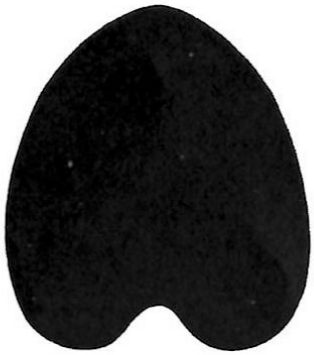

FIG. 20.—ANTHROPOID.

I found there were three types of female pelvis amongst those I had measured.

1. The perfectly circular in which *the whole of the body of the first sacral vertebra is outside the inlet.*

2. The transversely elongated, oval or kidney-shaped, in which the upper part of the sacrum has fallen forward and downwards and bulges into the cavity, helping to further diminish the available space.

3. The flattened from side to side as in certain cases of osteomalacia, where the woman squats on the ground and so determines the shape of the deformity. The ape's pelvis is of this shape and so is classified by Thomas as anthropoid.

(2) and (3) I believe to be pathological in woman.

The round with circular brim is undoubtedly the natural form in all women and among all races. Confirmation of this view is

obtained by comparing the male with the female pelvis in animals. The female pelvic brim in every case is rounder and more capacious than that of the male of the same species—*e.g.*, the mare, bitch, cat and cow compared with horse, dog, cat and bull.

Furthermore, every animal has a pelvic brim the shape of the presenting part of the animal to be born through it; *only man and only civilized man violates this law*, the civilized female pelvis being *oval* while the part of the infant's head which engages with it is round.

If we think of a cup and ball we can see that if the cup is slightly dented, or ever so little out of shape, the ball is prevented from entering, and so a pelvis with an ample circumference to accommodate the largest infant's head will prove too small if it deviates from the round in any degree.

An ordinary rubber ring through which a ball can just pass will make this clear, for by squeezing the ring into an oval the ball cannot pass.

This change of shape means loss of area, as can be easily demonstrated by making the sides of the oval approach one another until they are in contact and no area at all is then enclosed; the circumference remains the same while the enclosed area disappears. Mathematical calculations show how change of shape in a circle means loss of area.

A human pelvis whose diameter is 2 cm. at birth contains an area of 3·14 sq. cm.

A pelvis whose diameter is 11 cm. when adult has an area of 95·03 cm. to accommodate the fœtal head, and a round pelvis with a conjugate of 12 cm. (when the sacrum is in counter nutation) has an area of 113·1 sq. cm.

A circle whose diameter is 12 cm. ($4\frac{3}{4}$ ins.) is bent into an ellipse whose minor axis is 11 cm. ($4\frac{1}{4}$ ins.). It loses $1\frac{1}{2}$ per cent. of the area orginally enclosed, and so on progressively until with a conjugate of 8·3 cm. ($3\frac{1}{4}$ ins.) there is a 13 per cent. loss of area. As we know by practical experience, the smaller the obstetric conjugate the more difficult the labour; because the more oval the pelvis the less is its area. The value of the pelvis as regards childbearing depends upon the size of the circle which can be inscribed on the conjugate because the circle inscribed on the true conjugate indicates the size of the round infant head (S.O.B.)

conjugate: extends from lower margin of pubic symphysis to sacrococcygeal joint.

which will pass without compression, that is, with ease. Now we see why the modern pelvis represented in text-books as normal, when it is oval or kidney-shaped, cannot accommodate the ordinary heads our race is producing. The circumference is ample but badly arranged, and no wonder birth is difficult. We cannot squeeze a round head through an oval pelvis without damage. All talk of race improvement is vain when our finest children are squeezed to death in the birth process.

It will be seen, too, how a small round pelvis (especially if the

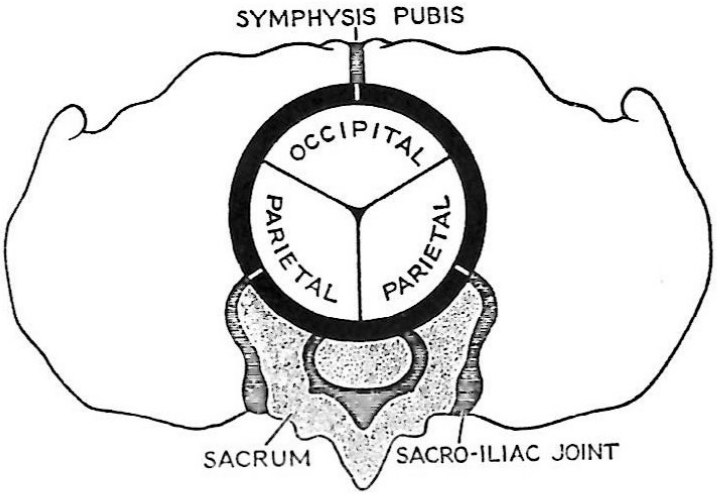

FIG 21.—FŒTAL HEAD IN MATERNAL PELVIS.

Looked at from above as if head were transparent. To show how the lines of compression in the skull alternate with the lines of expansion in the pelvis. Note how the sacrum forms part of the circumference of the inlet.

joints are flexible) will often prove adequate where a large flat pelvis is useless.

We shall later realize another advantage afforded by a pelvis with circular brim. It can be advantageously expanded at the articulations during parturition while the fœtal head is diminished at the sutures. This adaptation of pelvis and head is well seen in all animals, for during birth the joints of the maternal pelvis are forced apart at the same time that the fœtal head is squeezed together at the sutures.

Recalling the fact that the relation of circumference to diameter in a circle is expressed as $\pi = \frac{22}{7}$, then if the expansion is $\frac{1}{3}$ in. at each pelvic articulation that will give 1 in. increase in the whole

circumference of the brim, and that will be $\frac{1}{3}$ in. added to the diameter, so allowing the fœtal head a clearance of $\frac{1}{6}$ in. all over. If the fœtal head just fitted the pelvis at the beginning of labour, this increase in pelvic size is more than enough to turn the scale in favour of an easy confinement. But, as we know, the child's head can also adapt itself by packing up at the sutures. So it follows that if we have $\frac{1}{3}$ in. diminution at each cranial suture, we get 1 in. compression in the suboccipito-bregmatic circumference. This should give $\frac{1}{3}$ in. diminution in its diameter and a $\frac{1}{6}$ in. clearance all round. So that maternal pelvic expansion *combined* with fœtal head compression should give an extra $\frac{1}{3}$ in. clearance—all over the head, so that what was before a tight fit is now an easy one (J. Partridge). Similarly so small an increase as half a centimetre at each pelvic joint, combined with an equal amount of head compression, will allow of good clearance.

My work at the College of Surgeons and my final conclusions that the circular form was the true and original form of the female pelvis were communicated to my friend Dr. F. Stoney, with the suggestion that she should look out for such pelves when visiting Africa. Later she was able to confirm their existence by measuring a series of Bushman pelves in the Cape Town Museum—an accurate and valuable contribution to the subject.

The Fœtal Head

Now let us turn our attention to the fœtal head.

What part of the infant's head normally engages with the mother's pelvic brim?

We find that, unlike the pelvis, which differs in shape so widely even in the same tribe or family, the part of the infant's head which engages in the pelvic brim is *circular* in form among all people of whatever race, whether they are dolichocephalic or brachycephalic. This part is the suboccipito-bregmatic circumference, which in full flexion is brought into the maternal brim, and fits into the pelvis much as an egg fits into an egg-cup. It has recently been shown that it is in the plane of this circumference, and in this plane alone, that the fœtal head can safely be diminished in volume, while still preserving its circular form. Unequal pressure or pressure in other planes leads to tearing of the ten-

torium and hæmorrhage; one of the commonest causes of stillbirth and also of feeblemindedness.

Ehrenfest, Holland, Baker and others point out that a small pressure in the occipito-frontal diameter will tear the tentorium while a much greater force applied to the suboccipito-bregmatic will do no damage, thus showing that inadequate flexion of the fœtal head leads to tearing.

It must be recalled that the tentorium containing the longitudinal sinus lies in this plane, and during the reduction in volume which takes place with each pain, as the head is pushed into the pelvis, the convolutions of the fœtal brain are safe because they pack flat like the leaves of a concertina in the same plane or in parallel planes to the tentorium itself, and the uterine force merely flattens them against one another, whilst the pelvic walls act as a circumferential support.

Far different is it with other presentations of the head, evidenced by the fact that tentorial tearing with the accompanying hæmorrhage is a common sequel of malpresentation and is one of the commonest causes of stillbirth.

Now the occipito-bregmatic circumference measures roughly 13 ins. or 33·1 cm. and contrasts with the occipito-frontal or hat measure, which is given as $14\frac{1}{4}$ ins. or 36 cm. So that the advantages presented by the engagement of the halo measure with the pelvic brim are very great: first, because of its small size, it also means full and continuous flexion of the head and therefore uniform support to the delicate structures contained in the fœtal skull, and again because the infant head is more compressible in this circumference than in any other without fear of damage to its contents.

Now what prevents this beneficial reciprocal and progressive adaptation between mother and child having full play in every birth?

1. The altered shape of the mother's pelvic brim tending to faulty presentation of the fœtal head and the engagement of a circumference that is not circular and so not easily compressible.

2. Stiffness of the mother's pelvic joints, which do not open.

3. Wrong posture on the part of the mother for the act of birth, hindering pelvic expansion and increasing the effort needed.

In delayed or difficult birth one, if not all three, of these conditions are present.

In a round pelvis with flexible joints occipito-posterior positions may occur but do not give rise to much difficulty judging from African reports.

This occipital method of birth would seem to be peculiar to man. If one looks at the shape of the skull in ape or monkey there is no occiput to speak of; they are born snout first like all animals—horses, cattle, dogs, rabbits, guinea-pigs—whose forepaws are under the chin during delivery. After comparing the shapes of skulls with the shapes of female pelvic brims at the Royal College of Surgeons in 1929, I made enquiries in India, where the monkey is sacred. Professor Pan, an Indian doctor of the Lahore Medical College, writes: "Undoubtedly your view is right, the monkey is born face first." Professor J. Jarcho, in his recent book on posture and practices during labour among primitive peoples, reproduces Hartman and Tinkelpaugh's photographs of *Macacus rhesus* in labour taken at Baltimore (1929). Of 11 cases they photographed 6, and in 3 cases where they mention presentation it was the face that emerged first, as shown in the photographs.

I suggest that it is the fact of occipital birth being peculiar to man that has invested that part of the human head with religious associations. All Eastern people regard the occiput of man as specially sacred. Among Hindus one lock of hair is carefully preserved in that region. After death, on the funeral pyre, the head is broken to set the spirit free. Mohammedans always cover that part of the head however small the cap, and in pictures of saints and angels, both Christian and Buddhist, we see the holy man depicted as having a circle of light round the suboccipito-bregmatic circumference of his skull. I therefore call it the halo measure for short. In the West we have the monk's tonsure and the acolyte's cap just covering the occiput. In the maternity hospital, Calvados, Normandy, where there were weekly baptisms, the infants were held in their swaddling clothes, face downwards over the font, and baptised on the occiput.

This distinction between the birth of man and the birth of the ape seems to me a fact worthy of more attention than it has yet received.

CHAPTER III

THE OVAL BRIM AND ITS CAUSE

We have seen how advantageous it is as regards the birth of children for the mother's pelvic brim to be as nearly as possible a circle, not only because the pelvis is then more capacious, but also because it matches the halo measure of the fœtal head, so that they fit as a cup and ball fit one another. We see, too, how the more natural (and primitive) the life the rounder the pelvic brim and the easier is childbirth. Again we note the more nearly the pelvic brim approaches the circle, the more nearly circular are the other planes, and if the brim departs from the round form the more irregular in shape is the whole pelvis. Thus the transversely oval pelvis has an outlet which is oval antero-posteriorly, and the **Y**-pelvis characteristic of severe osteomalacia has an equally irregular and distorted outlet, whereas the round pelvic brim always co-exists with a well-shaped outlet, and such a pelvis forms a cylindrical canal during labour for the passage of the child.

If we expect the pelvic brim to be of circular form it is incumbent upon us to note how much the civilized pelvis of the text-books departs from this ideal shape, and if possible we must discover the cause of this change.

Piersol's "Anatomy" gives the true conjugate as 4 ins. and transverse 5 ins., while Cunningham gives the conjugate as $4\frac{1}{2}$ and transverse $5\frac{1}{4}$, but Gray's Anatomy, Eden and Holland, Fairbairn and Whitridge Williams consider the normal brim should measure:

Conjugate, $4\frac{1}{4}$ ins.
Transverse, $5\frac{1}{4}$ ins.

Fabre gives 11 cm. for the conjugate and 13·5 for the transverse in a normal pelvis, but speaks of the circular brim as also being normal.

Professor Pan, of Calcutta, taking the measurements of 100 Indian women (not purdah women), gives the average as—

Conjugate about 4 ins. or 10·1 cm.
Transverse $4\frac{1}{4}$ ins. or 10·8 cm.,

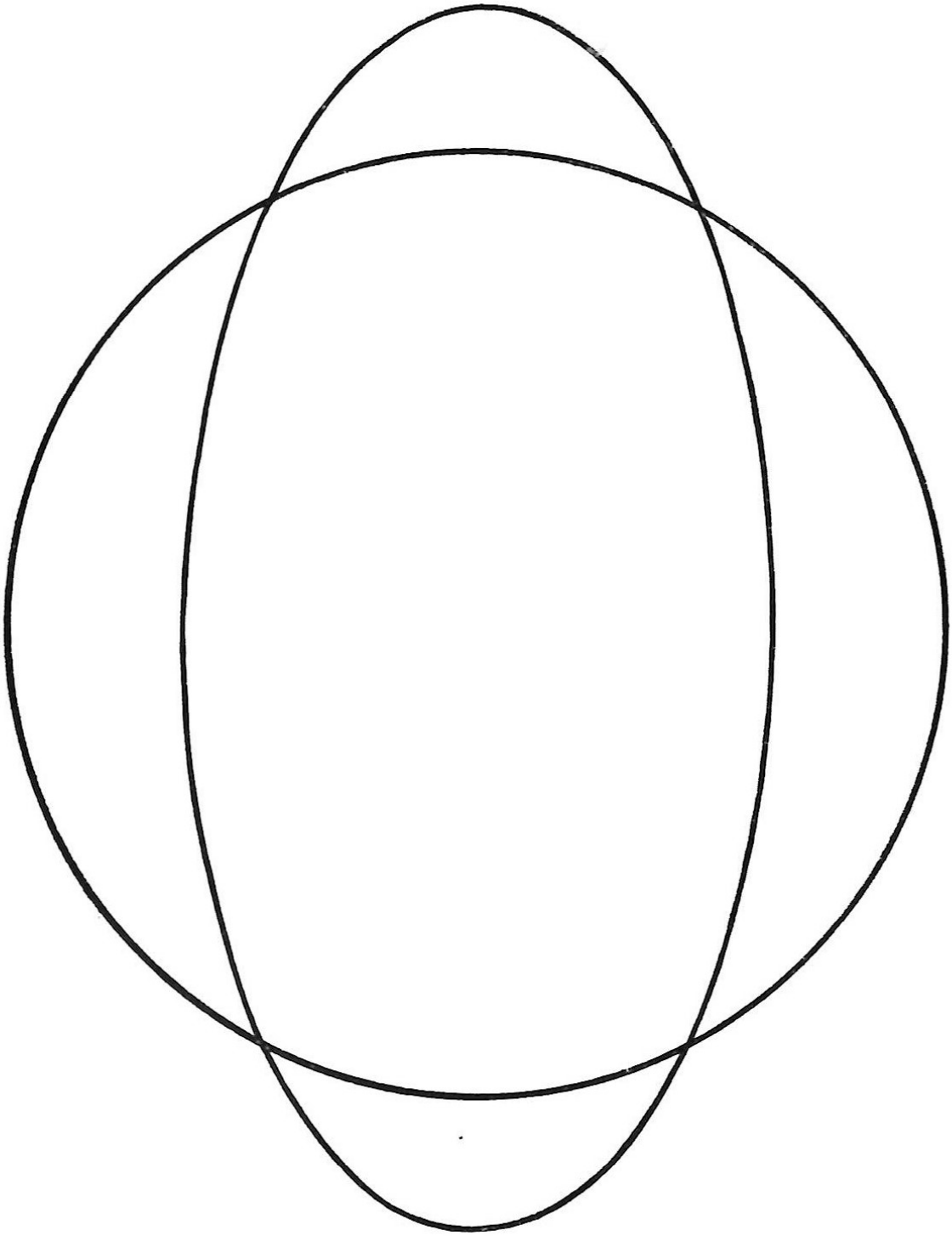

FIG 22.

The circle is the size of the normal round pelvic brim—*i.e.*, 12 cm. diameter. The circle and the oval have each the same circumference—*i.e.*, 37·7 cm. Note the difference in area enclosed. The oval with a conjugate of 7·7 cm. has lost 16 per cent. of the area.

but, as stated before, Indian pelves and Indian babies' heads are both proportionately smaller. The Indian pelvis more nearly approaches the circle in form.

It will be noted how the authorities differ among themselves as regards the correct measurement of the normal brim and even more so as regards the outlet, good evidence that the female pelvis has no definite fixed form.

However, the general consensus of expert opinion in England and America would show that the well-formed female pelvis of to-day has a true conjugate of $4\frac{1}{4}$ ins. and a transverse of $5\frac{1}{4}$ ins. This difference of 1 in. (over 2 cm.) between them indicates a considerable loss of area compared with a circular brim of the same circumference. The importance of the shrinkage in pelvic capacity is obvious, and we naturally ask the following questions: Is this alteration in pelvic capacity a hereditary change or is it acquired? If the change takes place in the woman's own lifetime, at what age does it begin and when is the transformation from round to oval complete?

Is it a change involving all parts of the circumference equally, or are some parts more deflected from the circle than others?

Lastly, what is the cause of this strange metamorphosis? Can it be due to the play of natural forces or must we seek for pathological conditions to account for it?

To answer these questions we must study the known facts about human growth and development.

Anthropological measurements show that persons of short stature *are* so because the legs are short, not the trunk, and the pelvis is also dwarfed with the legs.

Many observations have been made on growth in general, and carefully prepared tables have been published showing the rates of development of the head and limbs of children and of growing adolescents at different ages.

From some observations made by Davenport in America, there would appear to be two cycles when growth is most rapid, the first centring around birth and the second round the onset of sexual maturity. He says, with regard to the fœtus and young infant, that particular growth-inciting hormones come to the young through the placenta before birth and through the milk after birth, and that nothing subsequently quite equals in potency

PLATE I

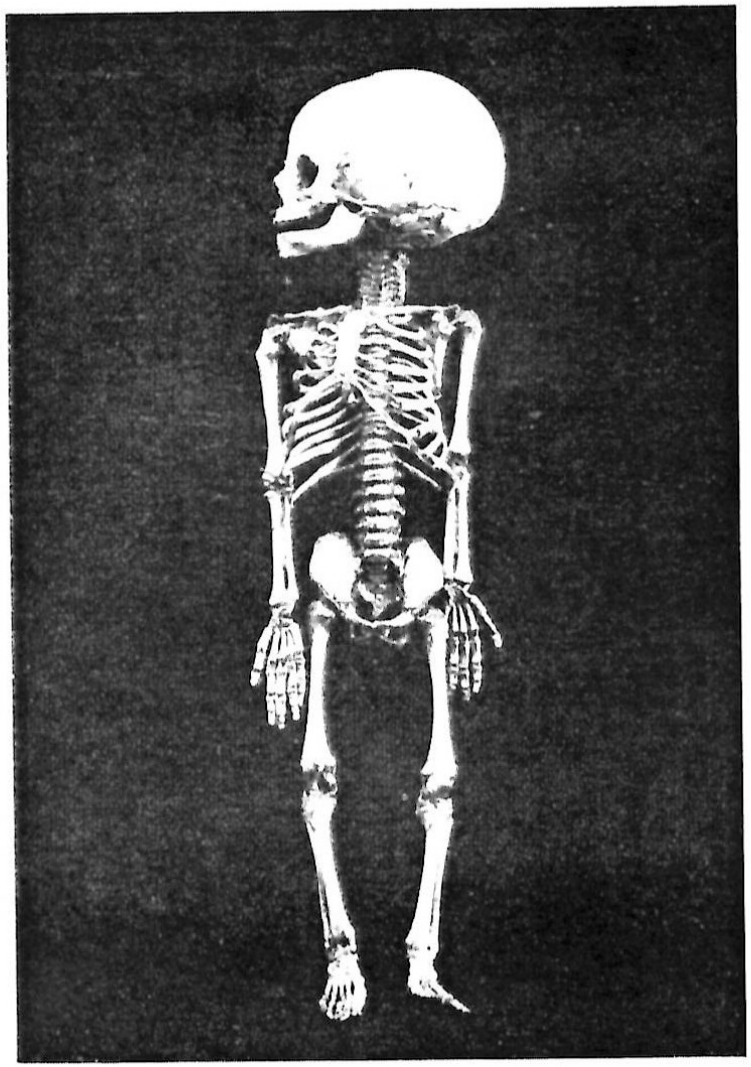

FIG. 24.—INFANT PELVIS AND SKULL.

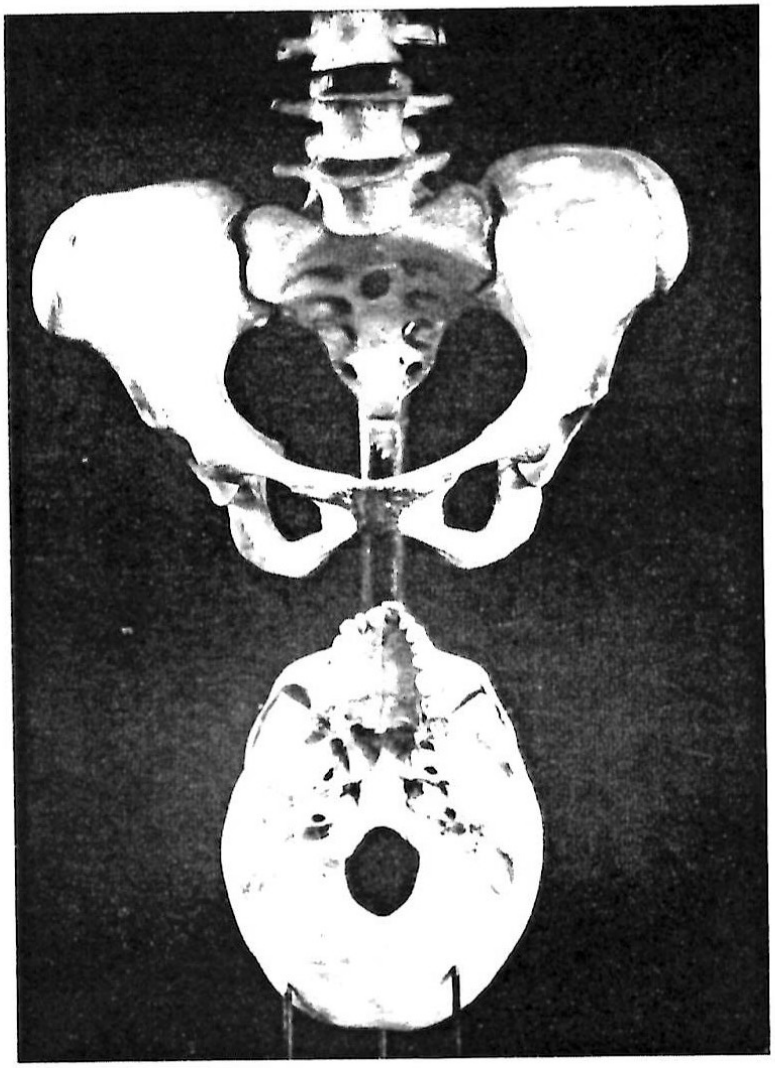

FIG. 25.—ADULT PELVIS AND SKULL.

To face page 49.

such gifts from the mother (C. B. Davenport, *American Journal Physiology and Anthropol.*, 1926, vol. ix., p. 205).

Other workers have stated that during the period one to eight years the child grows in *length of trunk* and limbs, but from eight to fourteen *the diameter* of shoulders, chest and hips doubles, and finally becomes more than three times what it was at birth. The period of rapid head growth is in the first cycle; of rapid pelvic growth in the second. It would also seem that the girl begins to grow and develop most rapidly between eleven and thirteen years, while in boys the period of rapid development is two or even three years later.

In preparation for puberty the girth of the pelvis rapidly increases and with it pelvic capacity.

I have prepared Figs. 24 and 25 to show that while the *head* of woman (measured round the suboccipito-bregmatic (halo) circumference) hardly doubles itself from birth to maturity, yet her *pelvic brim* becomes more than six times the size it was at birth.

Notice how large the head is at birth, the brain attaining its full size at seven years old; what a contrast to the tiny pelvis, only attaining its full capacity at puberty!

But in order to understand how the variations in pelvic shape, which make it oval or kidney-shaped, arise, it is necessary to recall the development of the pelvis itself from its pre-natal beginnings until sexual maturity is reached.

Now, sexual differences are present in the fœtal pelvis by the fourth month of intra-uterine life. At birth it is still merely a cartilaginous ring, with a diameter of 2 cm., containing forty-five centres of ossification, all in active growth and development.

Twenty-one of these centres are in the sacrum and twelve more in each innominate bone, so we have some idea how any failure in factors necessary to healthy and normal development of this important part of the skeleton may have far-reaching consequences in adult life.

To recall some elementary facts: the pelvis is made up of the sacrum behind, with the innominate bones forming the sides, each innominate bone consisting of three separate elements—ilium, ischium and pubis — united by a **Y**-shaped cartilage at the

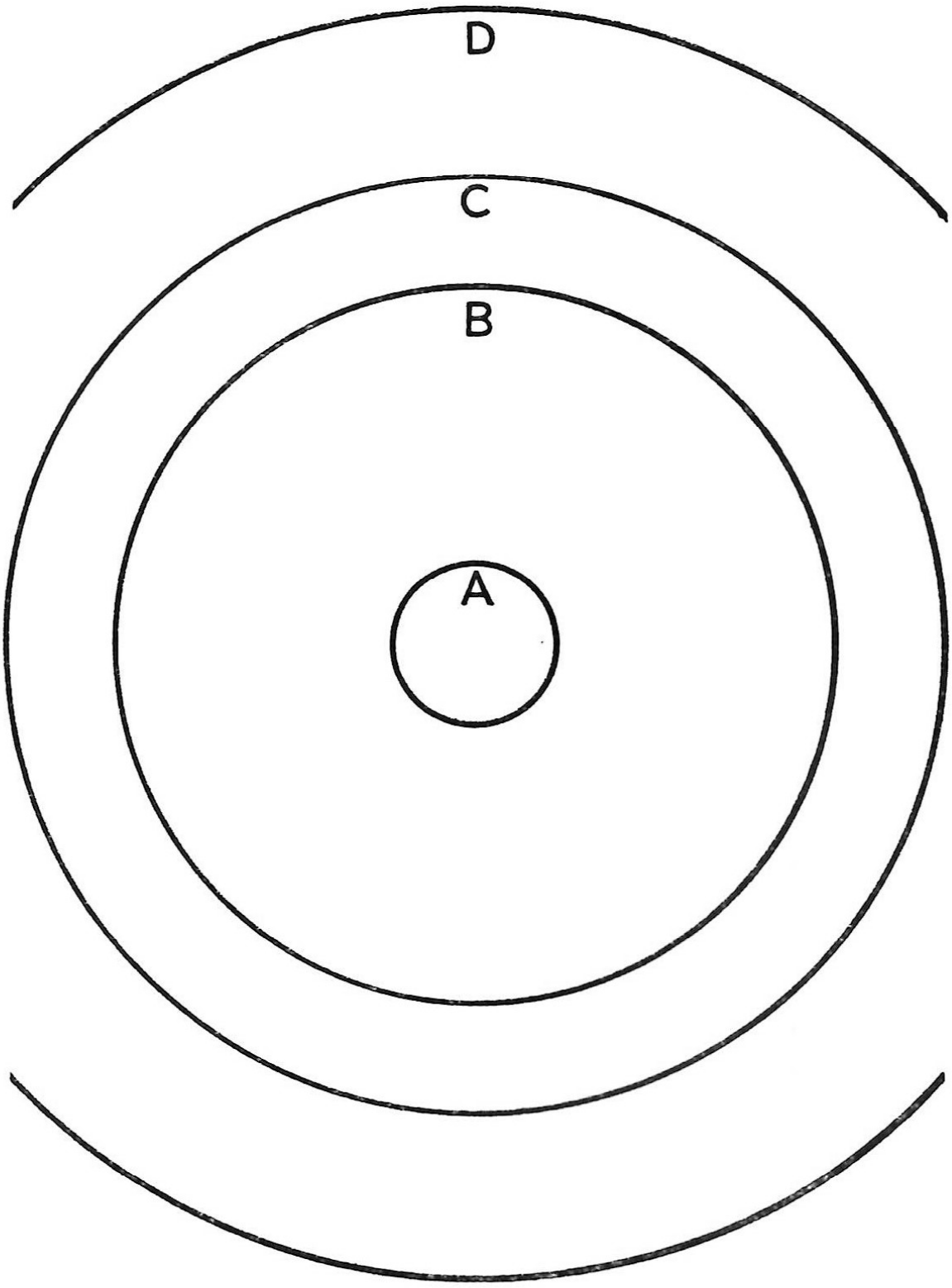

FIG. 23.—GROWTH OF PELVIS MORE RAPID THAN GROWTH OF HEAD IN WOMAN.

A, Infant pelvis at birth, circumference 6 cm.; B, Infant head at birth, 28·5 cm.; C, Adult pelvis, circumference 36 cm.; D, Adult head, circumference 51 cm. At birth pelvis small but head large, whereas in the adult the pelvis is large compared with the head. The pelvis is measured inside the brim, the head in the suboccipito bregmatic.

acetabulum. Realdus Columbus, of Padua, was the first anatomist to teach that each innominate bone consists of these three separate parts, which are not welded together until puberty; we may put the age at which the pelvis is thus consolidated as between eleven and fifteen, and we can see how this fusion once accomplished limits both movement and expansion.

The study of pelvic development teaches us that at puberty, or soon after, the shape of the female pelvis, be it faulty or otherwise, is fixed and unalterable, and although ossification still continues until twenty-five, it is at a much slower rate than before, and the previously elastic cartilage now forms a complete ring of rigid bone.

As the pelvis attains its final form at puberty we can see how the future mother has been made for better or for worse by that age. The only change *in shape* which can occur after puberty is caused by late rickets or osteomalacia, causing contraction and loss of pelvic capacity.

So much for development, but as regards shape the pelvic brim is circular at birth, if anything so elastic can be said to have a definite shape. It remains so until nine years old (Testut). Whitridge Williams says that about the twelfth year it may even assume an oval shape with the long diameter extending ante-posteriorly. Then just before puberty the sacrum increases so rapidly in width that the long diameter of the pelvic brim becomes transverse and remains so.

At fourteen years old we find an oval pelvis measuring $5\frac{1}{4}$ ins. by $4\frac{1}{4}$ ins. Why has the pelvis not preserved its pristine perfection of shape? We must seek to answer this question when we have seen what parts of the original circular brim have been thus bent out of shape.

On surveying any collection of pelves, such as that at the Royal College of Surgeons in London, we note in every case the divergence from the circular brim is at the *back* part of the pelvis, and involves the sacrum and all the parts immediately adjacent to the sacro-iliac joints, while the forepart preserves its original arcuate form.

As roughly two-thirds of the forty-five centres of ossification in the pelvis are behind a line joining the acetabula, it will be noted that it is the most rapidly growing parts of the pelvis (as we

might expect) that are the regions affected—viz., those at the back.

Not only does the circle become an oval (due to the different rates of growth at different ages in the three components of the terminal length of the innominate bone—Whitridge Williams), but a further important change follows, the displacement forwards of the sacrum.

The lumbar curve only develops as the child assumes the erect posture, and is caused by the upper end of the sacrum tilting forwards to keep the balance. This curve becomes more and more marked as an indoor life is imposed upon the growing child, and the sacrum remains continually in the position of nutation as in standing upright or sitting with the back hollowed.

In this connection Whitridge Williams points out that "the sacrum is not a keystone to the pelvic arch but the very reverse, for it is broader in front than behind, and thus acts as a wedge in counter-nutation, when it forces the innominate bones apart as it is drawn back by muscles attached to its posterior surface. So that when its supports (the sacro-iliac joints) are relaxed it falls forward carrying with it the iliac crests on each side, so changing the inlet first from round to oval, and then from oval to kidney shape." Also at puberty anæmia is not uncommon, and ligaments become relaxed. Long sitting at school, the wearing of heels (which exaggerate nutation), the avoidance of all exercise involving crouching or stooping, all weaken the sacro-iliac joints and encourage the unchecked falling forward of the promontory which then projects into the pelvic brim.

In man's natural state the free use of the sacro-iliac joints is accompanied by the swinging backwards and forwards of the sacrum, as in crouching, digging, climbing, rowing and swimming, and thus the tendency to displacement downwards and forwards is rectified, but the inactivity and more or less fixed posture entailed by an indoor and sedentary life as practised by the civilized does not permit of this reposition.

Brailsford, "Radiology of Bones and Joints," p. 318, states that there is a reduction of the sacral angle in the labouring class. That is what we should expect, for the to-and-fro movement of the sacrum is essential to their work.

As showing the effects of posture alone in modifying the form

PLATE II

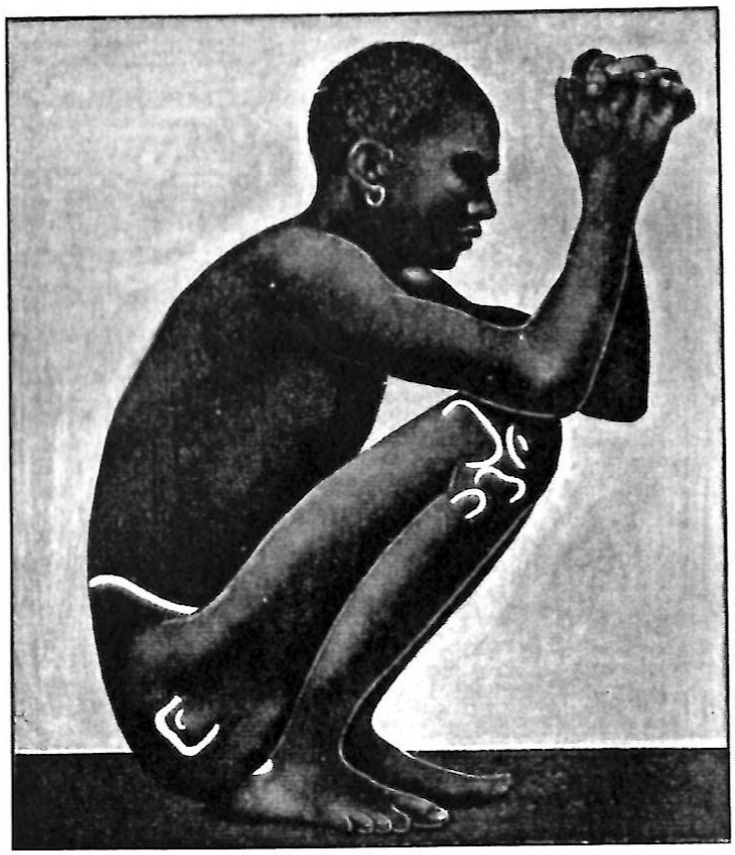

FIG. 29.—SQUATTING.

Showing how thigh rests on calf, and front of tuber ischii is in close apposition with the heel. Toes turned outwards. This is the ordinary position of rest. (Havelock Charles.)

To face page 53.

of the human skeleton, I would refer to Havelock Charles' paper in "Scientific Memoirs of the Army in India," 1893. He describes how in the Punjabi up to the age of ten or twelve, the lumbar vertebræ and intervertebral discs are of equal thickness back and front, but after that age, he thinks due to Eastern habits of sitting on the ground (which abolishes the lumbar curve), the bodies of the vertebræ in that region become thicker behind than in front, while the intervertebral discs become thicker in front than behind; but in the European the reverse effect is seen at puberty, for in him a more pronounced lumbar curve develops at that time, the vertebræ becoming deeper in front, while the intervertebral discs are shallower in front, no doubt due to the sitting on chairs and the increased lumbar curve engendered by that Western habit.

In speaking of these changes, he says that these anatomical characters (in the Punjabi) are obvious modifications in structure due to function, exaggerated by the squatting habits of the people, and, reviewing all the facts, he says the Punjabi skeleton furnishes definite examples of change in structure brought about by custom and habit, well seen in the lumbar region in the tibia, and in the hip, knee, and ankle joints (Fig. 29).

Again, Arthur Thompson, in "The Influence of Posture on the Form of the Articular Surface of the Tibia and Astragalus in the Different Races of Man and the Higher Apes" (*Journal of Anatomy and Physiology*, vol. xxiii., p. 623), states that the tibia presents more variation in length and form than any of the other long bones of the limbs of man. He shows how the antero-posterior diameter of the bone is increased by the large area required for the tibialis posticus which is brought into play by those living in mountainous countries and in hunters, and that this increase is found chiefly among those belonging to ancient or savage races. Its diminution is characteristic of the influence of civilization. He goes into details illustrating this point, and concludes by saying, "From the foregoing it will be sufficiently clear that in form the tibia undergoes frequent changes, and it will now be no less apparent that that change in form is due in most instances at least to the influence of posture." He further says, "There are grounds for believing that varying degrees of convexity of the tibial external articular surface indi-

cate use of the limb in the flexed position. The articular surface is flattest in those who do not as a rule make use of this position (squatting) and most pronounced in those where it is the customary manner of resting. In the ankle joint in extreme flexion the dorsal surface of the foot is approximated to the anterior aspect of the leg. Facets are present on the lower articular surface of the tibia and on the neck of the astragalus. He refers to Turner (*Challenger* Report, Part XLVII., 1886), who describes the presence of these facets in Andaman Islanders and in Australians, in most Indians and in all squatters.

It is of even greater interest when he goes on to tell us that these same facets are present in prehistoric man, as in the Cissbury skeleton in the Oxford Museum, in such marked contrast to the modern European type of skeleton. These facets are present, too, in the gorilla and orang.

He says how in young lads who ride much, such as boys employed in racing stables, the tibiæ show an outward curve, simply from the position so constantly assumed on horseback.

It is obvious then that in all growing children, especially before and at puberty, there is enough pliability in the bones to make long continuance in one position (such as sitting long hours at school) the cause of a permanent change of shape in them, especially long sitting on a still soft and growing pelvis.

Confirmation of the fact that posture and posture alone may deform the pelvis is given by St. John Brooks' research in Africa. He tells how Zulu girls at puberty are obliged by tribal custom to sit in a certain way, resting on the ground with all the weight on one thigh only, while the other leg is drawn up. He found skeletal evidence of pelvic deformation due to this practice.

Amongst Indian races the very common slight curving of the tibia outwards is undoubtedly caused by the habit of squatting from early childhood. I have noticed myself that it is marked among well-grown Sepoys in Indian regiments (their gaiters have to be cut to allow for the bend), and it is certainly not due to rickets. If further evidence is needed of healthy growing bone being deformed during growth, we have only to study the condition of the feet of adult Chinese women that were bound in childhood to keep them small. The whole foot is deformed, and the individual bones changed in shape. This binding begins at

nine or ten years of age, and is so painful that the little girls cry both day and night while it is in progress.

But enough evidence has been produced here to show that posture and posture alone can cause modifications in the skeleton of a person in perfect health. It is now necessary to consider the two special diseases which cause softening of bone, and therefore render it more liable to change of shape. I refer to rickets and to osteomalacia. Recent observers consider them as one and the same disease, similar in origin, similar in their cure.

Rickets and Osteomalacia

Curiously enough, with osteomalacia so common among the women, rickets among children is hardly ever seen in Kashmir. I have never seen a case in a boy, but remember two or three little girls showing marked deformity of the legs. They were all children belonging to rich families who had lost their mothers early, and so had been not only artificially fed but kept carefully indoors for fear of being kidnapped. Girl children are not seldom stolen as brides in India.

All children, especially boys (of whom the parents are proud while daughters are regarded as a misfortune), are taken out from birth and play naked in the streets, with only a little cap on the head and perhaps a string round the waist with a small talisman hung on it to ward off the evil eye. The rigorous seclusion of little girls known as "purdah" begins at eight years of age. Then they may no longer go out for fear of being seen by men, and are punished if they do. These children have all been breast-fed, and even those whose mothers have osteomalacia do not seem to be affected, for our Cæsarean section babies born of mothers with acute osteomalacia appeared strong and well nourished and showed no sign of rickets. In hospital the mother had usually enough milk herself and enjoyed feeding the child, but if her milk was inadequate other women in the ward were only too ready to oblige. Artificial feeding was not resorted to. Maxwell, Miles and Feng in China state that the fœtus of an osteomalacic mother does really suffer from rickets as revealed by X-rays, but it would seem that the customary breast feeding and exposure to sunlight rapidly cure this.

I lay special stress upon osteomalacia, because it was so prevalent among the patients in Kashmir. Every one of the better-class patients seemed to show signs of it, if it was only that the sacral promontory could be so easily felt on vaginal examination, and it was this that led me to see that rather than continue to perform operations on the women who suffered from the disease, it was incumbent upon me to find out the cause of such extreme pelvic deformity that in many cases practically no space remained for the passage of the child. Young married women, girls of only fourteen or fifteen, would come to the Zenana Hospital to have their first baby, after every effort had been made without success to deliver them at home. The native midwife, whose lore is traditional when in difficulty, will do a craniotomy with a sharp-pointed stick, and extract the fœtus with a piece of string looped over any available part. But the pelvis may be so crumpled up that it is impossible to reach the membranes and pierce them, much less to do a craniotomy. Cæsarean section was the only way out, and as most of our cases were septic before we saw them, we used to drain the abdominal wound for twenty-four hours after the operation and nurse them propped up in Fowler's position with quite good results. But more was needed. The *cause* had not been found.

It was the careful scrutiny of these cases that led me to see that the pelvis crumpled up into the **Y** shape so characteristic of osteomalacia is not due to hereditary disease as the people themselves thought, but is entirely attributable to factors operative in the patient's own lifetime—in fact, to conditions prevailing *before puberty* in nearly every case. Those *conditions* may be and often are hereditary, but the disease is *not*, it is always an acquired condition.

I therefore returned to England to learn more. I found, of course, that there were many explanations put forward to account for difficulty in childbirth, from the Garden of Eden and a curse on woman to the latest notion recently put forward that *fear* of the process causes difficult labour. One seems about as true as the other. No satisfactory reason was forthcoming to explain why the civilized suffered in childbirth more than the savage, and the woman living indoors more than the open-air dweller, however hard her work.

Having reached definite conclusions as to the purdah system and its effect in making normal childbirth difficult, I thought that possibly our present troubles in England as regards maternal mortality might also be due to causes operative in the woman's own lifetime long before she becomes a mother, in fact before puberty is established, and that the difficulties of civilized woman in childbirth might be caused by a modification of pelvic shape which was acquired and not due to racial or hereditary peculiarity, so that difficult labour in practically every case is due to faults in the development of the mother's pelvis *and can be prevented.*

It is necessary to lay emphasis upon the fact that the pelvis is the most rapidly growing part of the whole body, especially during the years eleven to fourteen or fifteen, and therefore we are prepared to find it the seat of disorders connected with faults of growth and ossification. What then are the common disorders affecting growth of bone? Rickets and osteomalacia—the latter coming more and more to be regarded as a specialized form of rickets. Both are characterized by undue softness of bone leading to change in shape, the phosphorus and calcium needed for normal ossification leaving the body in urine and fæces. The difference in the two conditions would appear to be that rickets attacks young and growing bone at the epiphyses, which are found to be tender on pressure, the calcium and phosphorus fail to be deposited in the growing cartilage so that the bone *remains* soft, whereas in osteomalacia fully formed bone (beginning in the regions surrounding the Haversian canals) parts with its calcium and phosphorus and *becomes* soft.

The sites of the primary lesions are therefore different, rickets attacking the epiphyses, at wrists and ankles, while osteomalacia affects the formed bones of the shaft, the ends of the diaphyses, which become painful to touch as the softening proceeds. In bad cases fractures occur at these spots (well known in Norway and New Zealand as occurring in affected cattle). These tender spots on ulna, tibia, ribs and pelvis are characteristic of the condition in women. They are situated in the forearm at the junction of the lower with the middle third, a position noticeably higher than that of the tenderness in rickets. In the legs the painful area is in the upper third of the shaft of the tibia, in the ribs about the middle,

in the pelvis there is complaint of generalized pain; but I have found on vaginal examination tender spots when touching the inner wall of the pelvis in cases of this kind.

I have dealt fully with osteomalacia in "The Purdah System and its Effect on Motherhood," which has an illustration showing the miserable state of a woman who had had many dead children previously. She was an advanced case of osteomalacia, and had been shut away from light in accordance with the social etiquette which demands the seclusion of high-caste women.

Dr. Preston Maxwell (*Journal R.S.M.*, 1930, p. 645) thus describes an acute case of osteomalacia in a Chinese woman of twenty-nine who had been unable to walk for two years. She was confined to the house, her diet was meagre, and she showed multiple fractures of the first ribs, both fourth ribs near spine, right fifth rib, right sixth rib in the axillary line and probably the eighth and ninth and the axillary border of the right scapula. He reports that in the pelvis the right pubic bone and both right and left ischium showed fractures, also the right femur just below the lesser trochanter, whilst the necks of both femora showed marked coxa vera.

X-ray studies of the bones in osteomalacia show the decrease in density of the parts affected, due to loss of calcium and phosphorus (Maxwell, Miles and Feng in China).

In all women who suffer from severe osteomalacia the teeth decay, the hair falls out, and there is often well marked tetany due to loss of calcium.

The patients can only rise from the ground or a chair with great difficulty, and help themselves up by placing their hands on their knees, then on their thighs and so gradually climb up and painfully straighten themselves. Later on they can no longer rise, and crawl about on the floor in extreme misery. Although pregnancy increases their sufferings, they are delighted when they know that they are with child, for every Indian woman considers herself worse than useless if she is not the mother of sons. Their condition now is indeed a pitiable one, for unless skilled assistance is at hand the pregnancy means death. Extreme anæmia is a characteristic symptom, and both ante-partum and post-partum hæmorrhages have to be guarded against.

The worst case of osteomalacia I ever saw was in a woman in Lahore, the wife of a motor driver. She had been confined indoors for ten years without ever going out. She lived in a small room behind her husband's shop, measuring about 8 by 10 ft., in complete darkness with only a wooden shutter, which was opened at intervals to throw out excrement into the street gutter, and then immediately closed. When I saw her for the first time she had been in labour for a day or two, the fœtus was already dead, and she was so deformed we could pass in no instrument, and on account of caste regulations her husband was unwilling for her to go to hospital for a Cæsarean, the only thing that might have saved her.

Cause of Rickets and Osteomalacia

Recent research tends to lay stress upon dietary deficiency as the cause of both rickets and osteomalacia, upon the absence of vitamins A and D, the evil effect of vitamin D deficiency being much increased by over-feeding with carbohydrate food (Mellanby).

But from my first-hand study of osteomalacia in Kashmir and the part played by want of light in the lives of those women suffering from the disease, I long ago stated my belief that want of light on the skin was the real cause of the condition. I published this view in 1927 in "The Purdah System and its Effect on Motherhood," in which I put forward my conviction that difficult childbirth either in the East or the West is caused by faulty pelvic development due to want of sufficient light on the skin during the years preceding puberty, and that diet is only of secondary importance.

In 1918 Mellanby proved that rickets could be produced by lack of fat-soluble vitamin (vitamin D), but Paton disputed this, for he found that *confinement in the dark* produced rickets on the same diet that was enough to keep the animal in health when in the open air. We see in Kashmir that men on the same diet as their womenfolk do not have osteomalacia, nor do women servants in the family, whose diet is likely to be poorer but who are able to go out freely into the sunshine like the men. The researches of Rosenheim and Webster (1926) explain this, for they

conclusively prove that vitamin D is made by the action of light *in the skin itself*, and that inactive substances in the food are eaten and then activated in the skin by sunlight. They found that this bio-chemical action takes place in the lower layers of the skin in the prickle cells, which contain a sterol known as ergosterol, the precursor of vitamin D. For ergosterol, when activated by light, becomes vitamin D. Now the presence of vitamin D in the body is necessary for the retention of calcium and phosphorus in teeth and bones. You may give any amount of calcium salts to an osteomalacic patient, but you will not cure her unless at the same time she gets more light. She does get more light when she comes into a hospital ward from her dark home. The sun is thus seen to be necessary for all bone and tooth development and for growth. As Dr. Rollier, of Leysin, points out in his book, "Heliotherapy": "The skin is an organ. It eliminates, and lubricates, it regulates the heat mechanism of the body, and now is found to be the great factor in calcium metabolism." He shows by X-ray studies taken in his own clinic how bone destroyed by disease is regenerated under daily exposure to sunlight, and claims that his patients show no wasting of the muscles even after years of confinement to bed, lying naked in the sunlight, but on the contrary he likens their harmonious development and beauty to that of young Greek athletes. I was privileged to study in his Leysin clinic for three weeks, and can testify to the truth of this description, and to the beauty of the human skin after such treatment.

Light and its Effect on Stature

Striking evidence of the part light plays in growth and development is afforded by a survey of different peoples in all parts of the world.

It is noticeable how outdoor races, such as nomad tribes, tent dwellers and outdoor workers are taller than those who live in deep valleys or in dark forests as the pygmy tribes, or those confined to cities, or whose work is indoors. Again, compare the stature of women with that of their men. Men and women among the gipsies and outdoor dwellers are found to be of much the same size (especially among the Powindahs, who live in tents travelling from place to place), whereas among those who keep women

indoors in seclusion, the man may be big and tall, but the woman is always much smaller.

In Switzerland, statistics have been published showing the influence of occupation on stature. The spinners and weavers, tailors and factory workers were found to be the smallest and the most liable to consumption. They, of course, live much indoors and in the towns which are situated in valleys. In Limousin, a rugged mountainous district of France, people living in the deep, dark valleys are all noticeably short, no man being over 5 ft. 1 in. in height, though children of the race taken in infancy to more open parts of the country, such as the Landes, arrive at normal stature.

In Kashmir it was very noticeable that the town Hindu was a small man, the village Hindu a fine upstanding fellow. The townsman's wife too often was a victim of osteomalacia or tuberculosis, or both, while her sister, living in a village and going out freely, was taller and quite healthy, having children with ease.

In England it is common knowledge that girls are increasing in size while boys seem to be diminishing in stature. Different clothing and habits of life probably explain this. The girl has as much of her body exposed to sunlight as possible, whereas boys are clothed up to the neck and down to the feet.

What are the conditions that cause light deficiency in Kashmir? Why should the women be unable to benefit by the light of the sun? The valley of Kashmir lies to the north of India proper, and is in the same latitude as the South of Spain. The River Jhelum runs at the bottom of the valley flanked by high mountain ranges. The difference in climate from that of Spain is due to the fact that the bottom of the valley lies 4,500 ft. above sea-level, and therefore has a temperate climate, cold in winter and hot in summer, but on the hottest days of summer the thermometer does not rise above 98° F., quite cool compared with the plains of India, where the thermometer often ranges from 100° to 120° F.

The city of Srinagar is built along the river banks and has been called the Venice of India, as the highways are the river and canals leading from it. The diminished altitude of the sun makes the winters dark, and the days short and bitterly cold; fog lies thickly over the valley reinforced by a pall of smoke

hanging over the city from the wood fires kindled to cook the evening meal. Snow lies deeply on the ground for several months, the temperature falls below zero, and the people then keep indoors as much as possible. The houses are mostly high, and of wood, built close together, and many of the streets are alleys where but one person can pass, the lower rooms being very dark. Most houses have a small courtyard round which they are built, often so small that the sun never shines into it even in summer. The rooms on the ground floor where the women live have only small windows, high up in the walls, for fear anyone should look in from the street. These are closed with lattice-work shutters, carved so that they form a web-like network, for the wood carvers of Kashmir are famous for their skill, and these patterns are traditional. But in the winter, to keep out the cold (which may be so intense that eggs are frozen hard in their shells and stand up by themselves when these are removed), oiled paper or old newspapers or felt rugs are pasted over the shutters for warmth. Glass is not obtainable. Although warm, the inmates are all in semi or total darkness. Electricity is cheap (the motor power is derived from the river) and so one electric bulb on a long flex will be carried from room to room.

I have visited patients, and the husband says, "I will bring the light," which means carrying the electric bulb from one dark room to the other and hanging the flex on a hook. With no exercise, the women feel the cold intensely and wear as thick clothing as possible, and do not change it in many cases until the spring. Under these conditions it can be understood that no light reaches the skin in winter, appetite fails, digestion suffers, teeth decay, and tuberculosis is rife in these families. And the cattle, in their dark underground stalls beneath the houses, contribute their warmth to those living above, but the poor beasts are short of food, and if let out into the alleyways will eat pieces of rag, paper and even excrement. It follows that their milk, so necessary for the women, is of poor quality. Everywhere the spring is greeted with joy, as the new grass springs up, covering even the house roofs with pale green verdure. It is amusing to see a sheep lifted on to the roof to graze.

If the purdah woman now goes out she is shrouded from head to foot in a long garment called a "burka," which has holes for

the eyes filled in with embroidered lattice-work. A life more completely deprived of light it would be hard to devise, and as we should expect, osteomalacia develops more rapidly in winter, and in spring the hospitals are filled with cases. Tuberculosis, too, both human and bovine, is rife.

Just as rickets is unknown among tinkers and gipsy children in Europe because their skin is freely exposed to sunlight, so osteomalacia is unknown among field workers in any country however poor the diet, so I was surprised to meet a peasant woman on the road in Kashmir gathering sticks, who showed the usual signs of osteomalacia, a very bent back and crooked legs. On questioning her I learnt that she was formerly the wife of a rich man and had been kept in strict seclusion indoors, but was now a widow, old and poor, and so was able to go out freely, and consequently the disease was no longer active.

Another Kashmir case (wife of an official who lived in a house whose windows opened on to the parade ground) only developed osteomalacia after her husband obtained promotion and his new residence was in the crowded city. Her first confinements were easy, but now she was again pregnant and had pains in the bones. Her pelvis was deformed, and she was a typical case of active osteomalacia.

The Hindus in Kashmir are a dwindling community—by their own statement they decrease by 1,000 a year. This is largely due to the deaths of so many mothers and children during child-birth.

In the Calcutta hospitals most of the Cæsarean sections come from the houses of the Marwari merchants. These people are rich and they live in expensive dwellings, great blocks of luxurious flats, but into some of the back rooms the sun never shines, and these are the ones reserved for the women as being more private.

In Bombay and on the west side of India we find the Borah community, also rich merchants, but they are Mohammedans and so live and feed quite differently from the Marwaris. But they have this in common with them, that they, too, shut up their women strictly. Difficult confinements are common and Cæsarean cases are plentiful, the pelves being so crumpled up with osteomalacia, just like those of the very poor women of the

weaver caste in the same city, who have to live behind the loom on the ground floor of high buildings in such narrow streets that even in summer the sunshine is cut off.

Extremes meet, the rich able to provide intensive seclusion, the poor man making the best of the little privacy he can afford. In both cases the women are deprived of light and the pelves suffer.

In delightful and happy contrast to these two classes live the Parsees, the richest community in Bombay; their women go out freely, and everyone is familiar with the sight of little Parsee girls going to school, happy and smiling. Their confinements in later life are easy.

Notice how distortion of pelvic form caused by osteomalacia may be found among rich and among poor, among Mohammedans and among Hindus, in the country and in the town, among meat eaters and among vegetarians, among those living on rice and among those whose daily food is wheat.

But the sufferers all have this one condition of their lives in common—the want of light. Light on the skin, essential to the production of healthy bone, is wanting.

Who are the women in England who have difficult confinements? Those brought up indoors.

All over the world the more strict the seclusion the more trouble there is in childbirth.

This is why the women improve in hospital *whatever the treatment*, because they are getting more light. Removal of the ovaries, as recommended by some surgeons as a cure for osteomalacia, has been found efficacious, probably because menstruation having ceased the woman is no longer kept in strict seclusion, and can go out of doors.

At the Zenana Hospital in Kashmir, several women with osteomalacia were given the same treatment with very little effect. The most severe case, who could not walk when she arrived, was the only one who improved rapidly, and after some time was able to walk by herself. I was told that this case was never in the ward, but sat all day beside the kitchen door in the open air and sunshine in the hope of getting constant cups of tea from the cook.

With exposure of the skin to sunlight, food deficiency seems

to be of little account, for, as Hess says, the sterols are so widely distributed in nature that a diet devoid of them would be difficult to find. Mustard oil is used in every cooking operation in Kashmir, not the refined oil, but oil freshly expressed from the seeds of plants growing in full sunlight. Milk and eggs, too, are plentiful and cheap.

Osteomalacia can exist apart from pregnancy, although a woman does not usually develop severe symptoms until she becomes pregnant, when the drain of calcium from her system is so much increased.

Dibbelt estimated that the fœtus required 0·17 gram of calcium oxide per diem, and in the later months of pregnancy this demand rises to 0·70 gram daily. Whitridge Williams comments upon this, that unless the pregnant woman can assimilate an unusual amount of calcium from her food, the fœtus has to be supplied from her own body, and that this is usually effected by partial decalcification of the maternal bones and teeth.

He quotes the well-known saying, "For every child a tooth," and suggests that a quart of milk daily is necessary to meet the need for calcium. In Kashmir, tetany was an early symptom, and toothache was one of the first complaints, the more remarkable as Kashmiris in general are noted for their strong and perfect teeth. The boatwomen and all outdoor workers show beautiful teeth when they smile, but the purdah ladies, living indoors, often suffer acutely from toothache and dental decay.

Cod-liver oil and fresh milk owe their curative action to their high content not only of calcium and phosphorus, but of vitamin D, and it is the presence of vitamin D, whether coming from the patient's own irradiated skin or from cod-liver oil and milk, that ensures the *retention* and utilization of the calcium and phosphorus in the food.

In Kashmir there are two indigenous remedies for the "bone trouble." One is the fish liver pills made by a Hindu woman who lives at the third bridge over the river, the market for the lake fish. This is, of course, a traditional remedy probably thousands of years old. An anticipation of our modern use of cod-liver oil and halibut-liver oil.

The other remedy is Baramulla earth—a fire-proof clay of which portable hearths for cooking are made. I found a lump

of it being eaten by an osteomalacic patient with severe anæmia, and brought a piece to England with me. It was analyzed, and showed calcium phosphate 16·2 per cent., ferric oxide 11·8 per cent., hydrated aluminium sulphate 71·2 per cent.

Of great interest is a case of osteomalacia in England recorded by Stoney, because it shows how similar conditions of life give rise to the same disease.

The patient was a caretaker who complained of great pain in the pelvis and inability to walk. She lived in a Bournemouth basement and probably only went out in the evening. X-ray examination showed multiple fractures of the pelvis (six) which healed up perfectly after cod-liver oil had been administered and the skin treated with ultra-violet light.

The part played by want of light in the production of rickets and osteomalacia was well shown by Harriet Chick and Dalziell's researches in Vienna during the war. They found that *on the same diet* as the others the only child in a ward who did not develop rickets was one near an open door and "whose cot was crossed by the sunbeams."

More interesting still, in the study of hunger osteomalacia, they state that they found a whole convent of nuns suffering from the disease, and the only one who was free from it was the garden sister *on the same diet* as the others, but her life was spent in the open air.

The same workers dealing with these cases of hunger osteomalacia found the disease common among the elderly and respectable of both sexes, who did no work. They probably lived much indoors to hide their poverty and keep warm.

As I noted in "The Purdah System," on seeing an old woman who had osteomalacia in her youth cross the Zenana Hospital courtyard in Srinagar supporting herself with two long sticks grasped in each hand, one was irresistibly reminded of the mediæval witch. There was the halting gait, the bowed and humped back, the head sunk between the shoulders, the old wrinkled face and nutcracker, toothless jaws, the typical old hag as she has been described in fairy stories. These women in the Middle Ages, just as in Kashmir now, were widows and poor. To hide their poverty they kept indoors and went out at night to gather sticks and see what they could find and get from their

neighbours. Hence their evil reputation. Want of food and light caused hunger osteomalacia, which changed their whole appearance. For light is a food, and can make an inadequate diet adequate. Growth of bone and teeth does not take place normally without it, and the want of it causes adult teeth to decay and adult bones to bend.

Further evidence of the necessity of light in preventing rickets is afforded by Luce, who found that the milk of cows kept in the open air and fed on fresh food was curative of rickets, whereas the milk of cows kept on dry food in a dark stable was not. But if this inadequate milk was irradiated, *or* the persons consuming the milk were exposed to sunlight (or any artificial source of ultra-violet light), the deficiency of vitamin D was made good, and the rickets was cured. These experiments prove that sunlight is *the* important factor and not diet in calcium metabolism. This view is strengthened by Luce's final statement of his findings, that the cow in the open air fed on fresh food produces *more anti-rachitic vitamin than she takes in.* The milk of cows kept by rich Hindus in an Indian city is often deficient in vitamin D because the cattle are kept in a cellar or tied up in a dark narrow passage-way between two houses and fed on dry food and hay on account of the expense of obtaining fresh grass in a city.

Thoms, in "The Obstetric Pelvis," says that the shortest labours are those in which the pelves are large and round. He quotes Hauseman in support of the view that rickets is due to the abnormal conditions which accompany "domestication" in man, and considers that "many pelves are rachitic without any other evidence remaining of childhood rickets." Jarcho also tells us that the shortest labours occur in those cases where the pelvis is large and round.

CHAPTER IV

GAIT AND TEETH AS INDICATORS OF PELVIC CAPACITY

THERE are two ways of making a rough estimate of pelvic shape and capacity when the pregnant woman first comes before the doctor.

1. By her gait.
2. By her teeth and jaws.

The Gait.—It has been recognized for many years that gross lameness means a deformed pelvis and that the earlier in life the lameness begins the greater is the deformity which results, for a lame leg means that the sacro-iliac joint on that side has its range of movement curtailed. Consequently there is a modification or failure of pelvic development and the ilio-pectineal curve is flattened on the same side as the lesion.

Again we note how the ankylosis of a sacro-iliac joint will change the gait in a given case, although the question of which is cause and which is effect may be a difficult one to answer, for ankylosis of pelvic joints leads to change both in the shape of the pelvis and in the gait. Conversely faulty gait, such as a lame leg (perhaps due to fracture or dislocation), influences the pelvic joints, curtails their range of movement and will eventually alter the shape of the pelvis itself.

My interest in the way obstetric patients walked was aroused by Miss M. A. Hutchinson, the English matron at the Kashmir State Hospital in 1916, when she said that when she saw a woman come in with feet turned in and looking as if she would fall over her big toes, she always expected and prepared for a Cæsarean section. This walk is the typical gait of osteomalacic patients and goes with the **Y**-shaped pelvis. In England one commonly sees the opposite condition, the *turned out feet,* and the flattened or oval pelvis which goes with them.

Now several efforts have been made to find out what is normal human gait, and two outstanding investigations come at once to mind—first, that conducted on American college women by Brad-

ford, of Boston, where the students walked across a platform sprinkled with sand, and their footprints were carefully noted.

The general conclusions reached were that the stronger and more athletic the woman the straighter the gait—*i.e.*, the midline of the foot running parallel to the line of advance—and that the angle of gait in women becomes wider than that in men as the pelvis widens.

Another study of the angle of gait is by Dudley J. Morton (*Journal of Bone and Joint Surgery*, October 18, 1932), and he gives the results of careful observation of footprints of 1,000 native men, women and children in the Belgian Congo.

The average angle made by the feet with one another was determined as 7·5 degrees, slightly greater than that obtained from the college women in America. The observers state that they consider 5 to 10 degrees is a normal variation (they often noted a difference in the angle between the feet in the same person, one foot being more turned out than the other); 72 per cent. were between zero and 15 degrees; 13 per cent. showed 15 to 20 degrees out-toeing; 15 per cent. showed *in*-toeing (the rarest). Unfortunately we are not told age and sex of the individuals, as in my opinion this is very important.

The author says: "The angle of the foot in walking or running is determined essentially by the position of the femur in its 90 degrees arc of rotation at the distant hip joint and in-toeing shows internal rotation of the femur, whereas out-toeing goes with external rotation.

"In running and sprinting athletes point their toes straight forward . . . lateral balance is not necessary, if he falls it will be straight forward.

"Our need for lateral support increases with the slowing of gait and decreases with faster movement. Rapid pace closes the angle of gait and slow walking widens it."

It is remarked by the above writer how smooth floors and pavements make the angle more constant, while the uneven surfaces of native life encourage much freer movements of hips and feet.

When looking at natural gait such as obtains among people who habitually go barefoot, as many Kashmiris do, I have noticed that the heel bears the chief weight of the body, while the outside of the sole and the heads of the metatarsals and toes are sub-

sidiary. The arch of the foot comes nowhere near the ground, and is merely a *temporary bearer* of weight as the body leans forward, and the weight is then transferred to the metatarsals and toes and finally to the other foot.

In quick walking, any strain on the arch is ephemeral, so quickly does it pass from heel to toe, but in slow walking, as necessitated by an indoor life, the pace is slowed, the angle of the gait widens, and there is sustained pressure on the arch, tending to flatten it, and destroy all spring. In fact, pressure and weight both fall on a part of the foot not intended as a weight bearer at all.

There could be nothing worse for the feet than slow movement, and above all for children, those miserable nursery and school walks in company with the elderly and infirm, with little feet encased in stiff shoes constructed to encourage weight being borne on the *inner* instead of the outer side of the foot, on the arch rather than on the outer part of the sole. One has only to look at the wet footprints of a healthy child on the bathroom floor to see where man naturally throws his weight.

It seems to me that quick walking and sprinting are the cure for flat foot, not arch supports.

But the gait only interests us here in its bearing on pelvic shape. With this idea in view I was able by the courtesy of Dr. Albert Lachapelle, of Bordeaux, to conduct an investigation on fifteen cases at the Pellegrin Hospital, where we were able to see the definite relationship between the patient's walk and the shape of the pelvis (1933).

We took the footprints by oiling the feet and then making the patient walk on a strip of plain wall-paper spread on the ground. The footmarks were later on blackened before being photographed.

After that each patient was propped up in a sitting position at an angle of about 70 degrees with the table and the pelvis was X-rayed by Dr. Lachapelle.

We found that any peculiarity of gait was reflected in the shape of the pelvic brim.

At first we had some delay in securing patients, so we began with the hospital cook, who was crossing the courtyard. He was a man with a mouth full of bad teeth and his gait was remarkable, his feet were so much turned out. We persuaded him to be

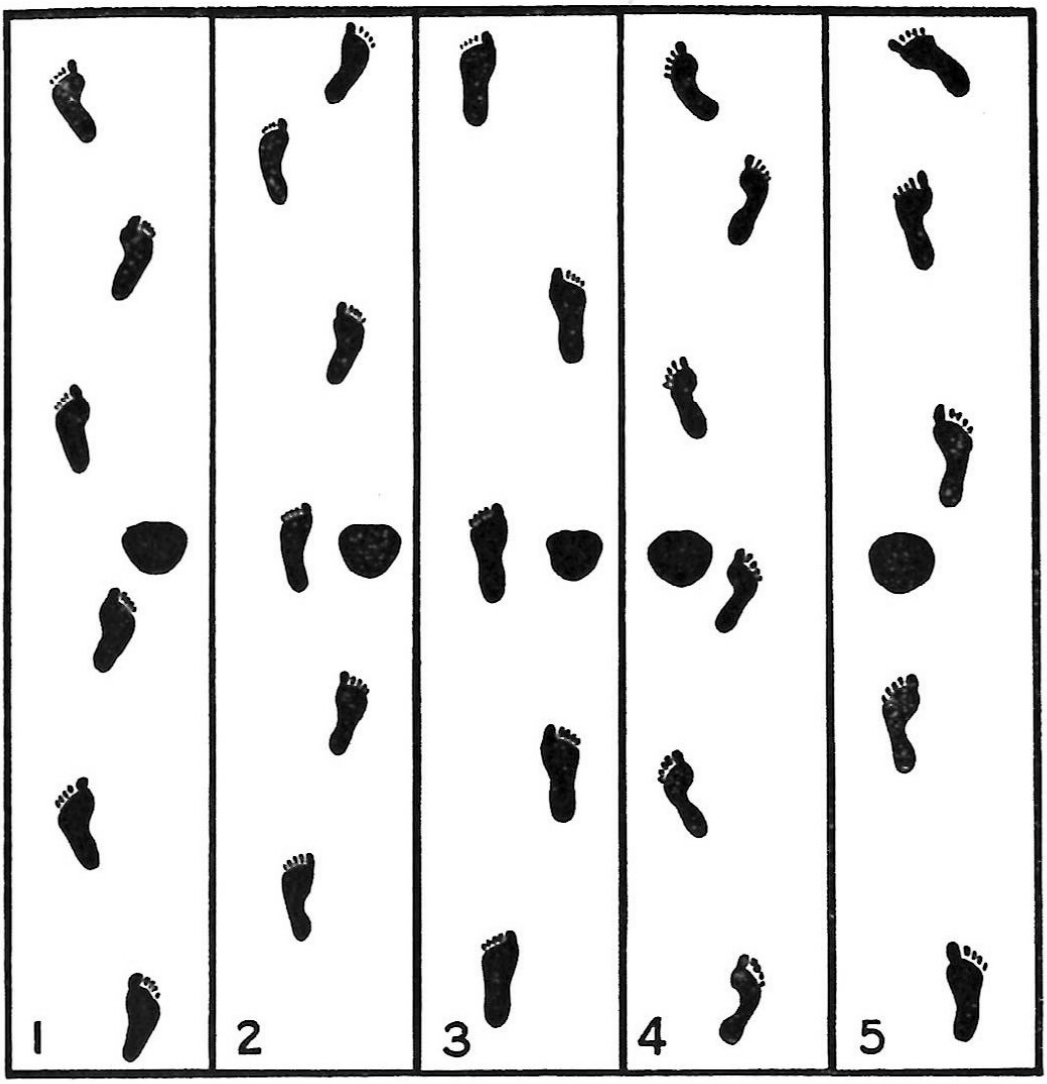

FIG. 26.—FOOTPRINTS SHOWING GAIT.

No. 1. (36 in register). Fourth pregnancy. Has had no difficulty; had twins last time. She herself was breast-fed for one year. Walked at twelve months. Confined, no trouble; 3·7 kilo baby. Labour lasted 7 hours 50 minutes.

No. 2. (37). Seventh confinement. All have been easy. Confined, no trouble.

No. 3. (41). Aged 19. Has always had good teeth; no extractions. Was breast-fed herself. 40 hours in labour; easy delivery; male 3·7 kilos. Presentation breech; had been a question of Cæsarean.

No. 4. (108). Teeth bad since she was pregnant. Walked at ten months; always lived in country. Easy confinement.

No. 5. Italian, aged 43. Seventh accouchement. Three alive; three miscarriages. Good teeth; no extractions before fifteen. Patient was herself breast-fed. Easy confinement.

X-rayed, and the pelvis was found to be flattened almost like a female pelvis, as may be seen in Fig. 27, No. 8.

From this we see that useful information can be gained by taking the patients' footprints in sand or on paper with chalk or oil and noting the angle made by each foot with the line of progression.

The woman who walks with her feet symmetrically placed on the ground pointing almost straight forward parallel to the line of march has a round pelvic brim. The woman who turns her feet out has the (civilized) oval pelvic brim of the text-books. As the feet are more or less turned out so is the deviation of the pelvic brim from its true shape greater or less, and we found that:

1. One foot turned out shows a transverse lengthening of the same side of the pelvis.
2. One foot turned in, contraction and flattening of the same side of the pelvis.
3. Both feet turned out, a wide or flat pelvis.
4. Both feet turned in, lengthening of conjugate and finally Y-shaped deformity.

Now we are in a position to see how much the civilized pelvis has changed its shape. For the position of the feet shows the condition of hip and sacro-iliac joints and how they are used, for by their activity the pelvis is moulded, and its shape determined, not only from birth to puberty, but all through life, as our illustration (Fig. 27, No. 9) well shows—an X-ray of the pelvis taken in an elderly man ten years after fracture of the femur. The pelvis, as we should expect, has become misshapen on the side of the injury.

We understand, too, how the wearing of artificial heels by women can change the shape of the pelvic brim and diminish its capacity, and the earlier they are worn in life the greater is the deformity produced. They are often $2\frac{1}{2}$ to 3 ins. high—$4\frac{1}{4}$ ins. in England, 10 ins. is the maximum in America. They throw the body weight forward on to the arch (which should bear no permanent weight) and on to the ball and toes of the foot. The body has its natural poise upset, for the lumbar curve is accentuated and the sacrum is in the position of extreme nutation, the promontory tilted forward, so that to keep the balance at all *the toes must be turned out* and the basis of support increased—the

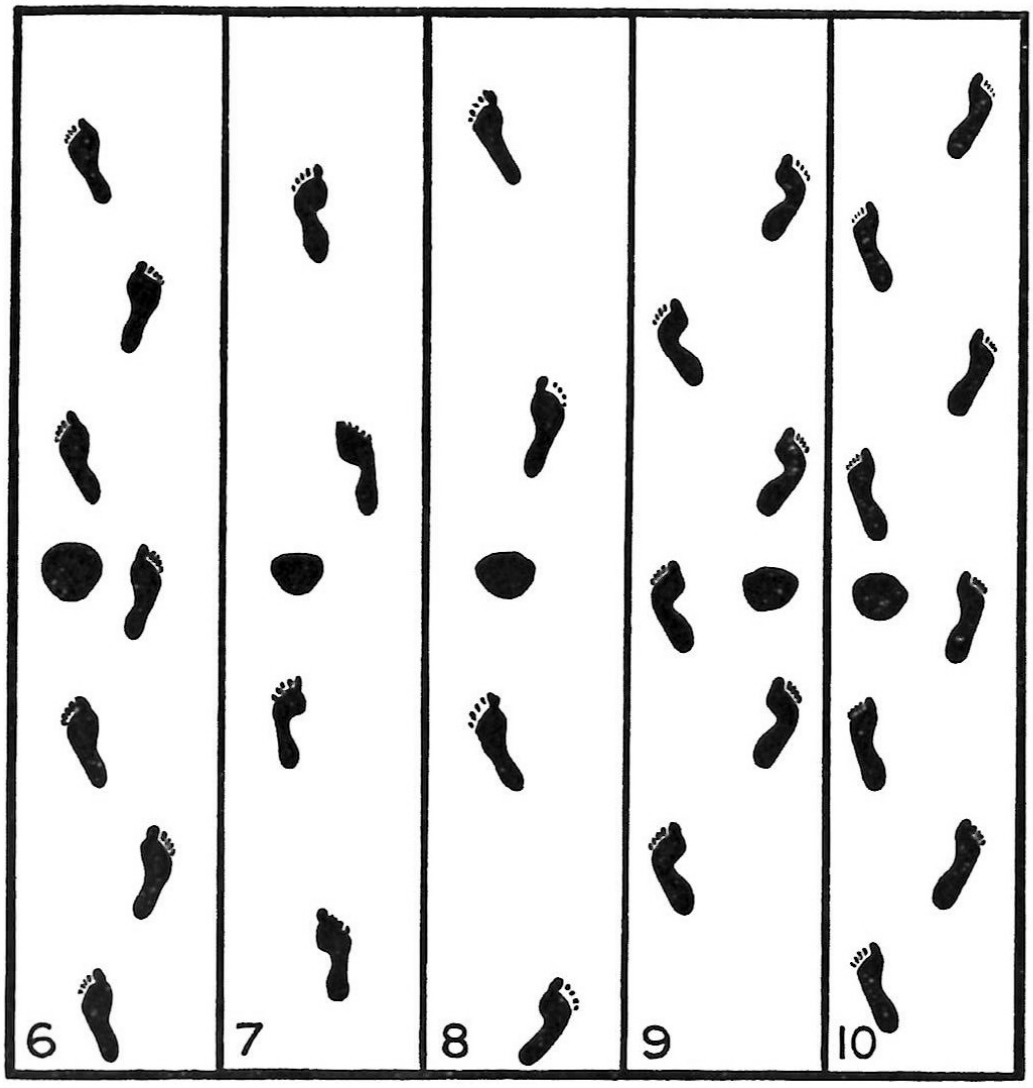

FIG. 27.—FOOTPRINTS SHOWING GAIT.

No. 6. (54). Aged 22. First confinement. Teeth very good; was herself breast-fed. Normal confinement.

No. 7. (48). Aged 31. Male from Jibouti. Teeth good; water on knee.

No. 8. (50). Aged 30. Male; the hospital cook. Feet turned out even when standing. Never saw his mother; fed on cow's milk. Teeth very bad; said at twenty-three they were decayed.

No. 9. (84). Old man. Fracture of neck of femur ten years ago; shortening 7 cm.; walks with a stick.

No. 10. (52). Male. Rheumatism for last fifteen years; four years ago slight hemiplegia left side; walks with a stick.

dancing master position. Nothing could be worse from an obstetric point of view; the flexors of both leg and thigh are weakened and lose tone, the back broadens in the gluteal region and the knees can only be fully extended with difficulty. In old age the feet are turned *out* to keep the balance, the natural stance of the aged, while the opposite state of things is seen in the infant who in learning to walk turns the feet *in* to get his balance.

The schoolgirl who habitually treads her shoe down on one side will eventually be found to have a corresponding pelvic lesion. If the shoe is trodden down on the inner side only then the ilio-pectineal line is flattened, or if on the outer side the pelvis will be found to be widened transversely on that side.

Constant use by children of the scooter, in which all the weight is on one leg, is obviously most undesirable, just as sitting for long periods with the weight on one ischial tuberosity, as in writing at a desk, is liable to induce deformity in the pelvis on one side, usually the right, before the child leaves school.

The wearing of tight elastic belts by young girls, which cramp the sacro-lilac joints, also hinders normal pelvic development, and may end in the production of the funnel-shaped pelvis such as we see so commonly in America, a very real factor in race degeneration.

For a pelvis to be in a healthy condition, either in man or woman, the joints *must* be exercised daily from birth, and nothing can replace the system of gymnastic exercises designed by nature. These are comprised in the squatting attitude, the natural position for defæcation, still used by the majority of mankind, universal in the East, and all over Europe in country districts. So universal is it that in France, in hotels in the provinces, provision is made for this common need. It keeps the pelvis mobile, and improves the circulation within it, while the musculature attached to it is kept in condition by constant exercise. It would seem that among races where this custom obtains, cholecystitis is rare, appendicitis not known, cases of fibroids in women and prostatic enlargement in men few, and cancer almost unknown.

This position provides massage for all the pelvic organs and renders defæcation easy. The higher the closet seats in a community the more constipation. With this goes difficult child-

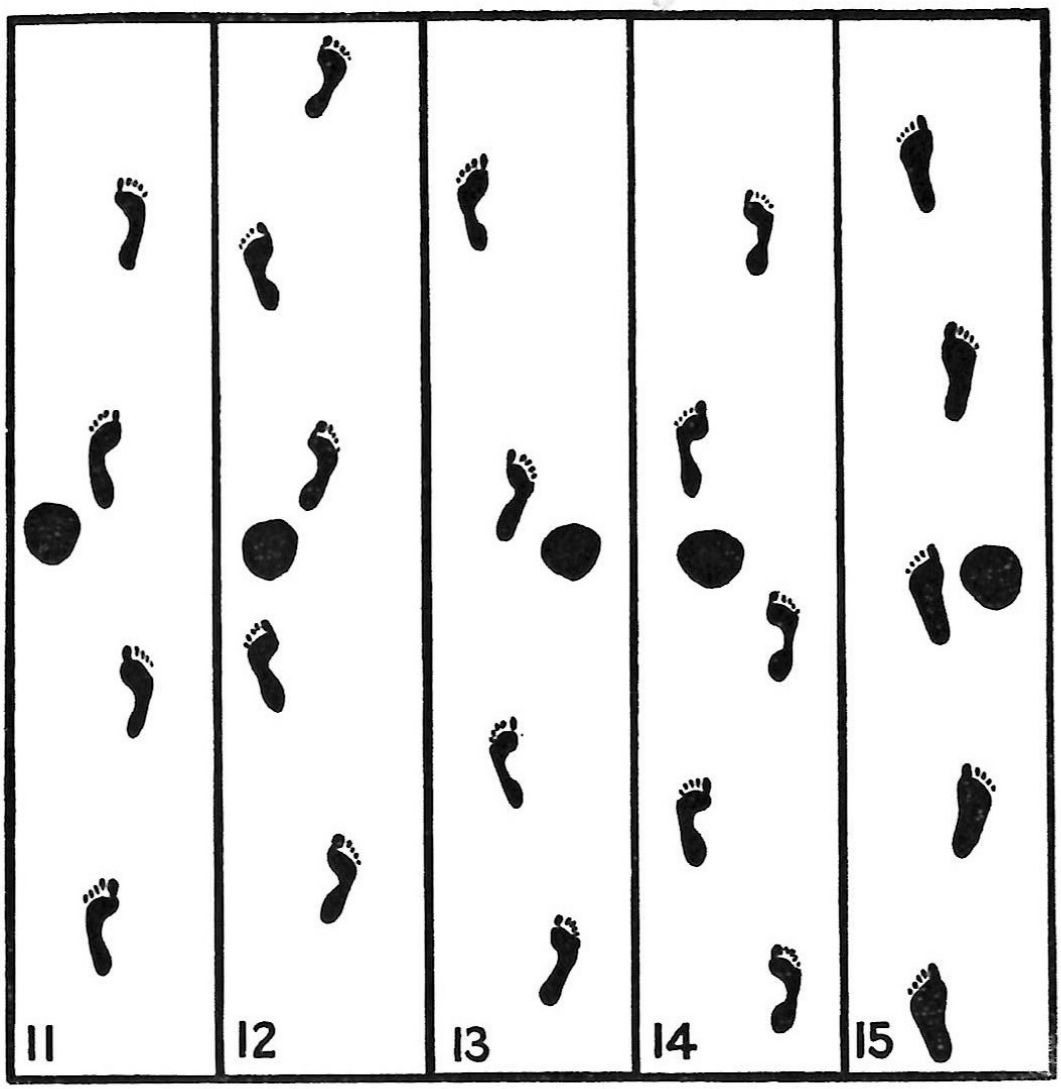

FIG. 28.—FOOTPRINTS SHOWING GAIT.

No. 11. (55). Aged 19½. First confinement. Excellent teeth at fifteen; two taken out since then. Mother died when two days old, so was brought up by Assistance Publique.

No. 12. (66). Aged 18. First confinement. Teeth good at twelve; she was breast-fed herself. Normal confinement.

No. 13. (64). Aged 29. First confinement. Very bad teeth, only one left in upper jaw; black stumps. Teeth bad from six or seven years old, but says she was fed by her mother. Forceps case.

No. 14. (77). Aged 24. Lame; has had sciatica for two and a half months. Expecting second confinement; first was easy. Her own mother only nursed her for four months. Always had bad teeth.

No. 15. (35). Aged 29. Expecting seventh accouchement. Has never had any trouble with any of them. Teeth perfect at fifteen; beginning to go now. Was nursed by her own mother for eighteen months.

birth, because the pelvis is rigid, lacks exercise and *cannot expand*.

Now dancers, who should have perfect gait and movement, are said to have difficult confinements. In spite of much exercise I think the reason can be found in the fact that to dance on the extreme tips of the toes the pelvis must be held rigidly *in its most contracted position*. The bearing of many children would soften all ligaments, relax the joints and ruin a danseuse. Her sacro-iliac joints and ligaments would never recover the necessary rigidity to enable her to spin round on the tips of her toes.

At Bordeaux I visited the annual fair, in which was a large circus. After the performance I tried to get permission to have X-ray studies made of the pelves of the children and young girls who did "splits," but the manager refused. If they could have been obtained they would have given ocular demonstration of possibilities of pelvic movement of which we have very little idea in civilized life.

It is obvious why the wearing of high heels and the use of the high closet seat are undesirable—they limit the normal movements of the pelvis and favour early rigidity.

The Teeth

Among all people where childbirth is easy, safe, and natural, good teeth are the rule.

Perfect teeth, easy motherhood, because perfect teeth *cannot exist* with rickets, however slight; therefore the round pelvic brim and perfect teeth are found together.

This is borne out by practical experience, not only in the East, but among all peasant and open-air populations, and to-day in many places in Europe a girl has no chance of marriage unless her teeth are good, for this is one of the first things the prospective husband looks for.

"A diamond is not as precious as a tooth."

"In Greece it was considered a virtue to shave frequently and to have white teeth."

"The Turkish wooer visiting the girl of his choice attempts to make her laugh—so as to see her teeth if they are good" (from "Folk Lore of the Teeth," by Leo Kanner, pp. 50 and 63).

Bad teeth show old age and debility, and neither are desirable

characteristics in a bride. "It may, at any rate, be said of most Tibetan women that they are of strong physique, and that their cheerful faces break readily into smiles, radiating health and intelligence, and showing to advantage their strong white teeth" (from "The People of Tibet," Sir Chas. Bell, K.C.I.E., C.M.G., p. 148). We have already stated that they have no trouble in childbirth.

We have high authority for connecting bad teeth with rickets, for the Medical Research Council, 1928, on "The Health of the School Child," tells us, p. 125, that "defective calcification of teeth, regarded as one of the bony results of rickets . . . is permanent in character, the poorly calcified tissues never being replaced," and "the dental structure is on this account perhaps the most reliable evidence of old rickets."

Now in 1931, in an examination of children in London County Council schools, 60 per cent. of five-year-old children were found to have extensive dental caries, and only 8 per cent. were free ("Diet and Health," E. Mellanby, *B.M.J.*, March 21, 1931), and he adds, "There is no reason to suppose that these teeth are any worse than those of the average child of the same class in the British Isles."

Again, *B.M.J.*, August 26, 1933, p. 367, L. J. Harris says that 80 to 90 per cent. of all elementary school children in London have rickets in some degree.

We thus get an idea of the prevalence of undetected rickets in the community and see how the state of the teeth is a delicate and reliable proof of the presence of this disease, for the teeth have been affected long before rickets as such is noticeable.

Mellanby states that as the temporary teeth in children are not fully erupted until two or three years old, the conditions, such as food and exposure to light prevailing between the time of weaning and the full eruption of these teeth (about eighteen months), are most important, and, further, that the calcification of the permanent teeth is also profoundly affected by the mother, and that she should normally endow her offspring with a store of calcifying substance, and must get her own vitamin D from food or from sunshine on the skin.

A definite relationship has been established between defectively calcified teeth and rickets in dogs. The teeth are a good index of

the calcification processes taking place at varying periods during development, for the tissues once laid down are not later re-absorbed, as is the case with the bones. The Mellanbys showed by experiment that good or bad teeth can be produced at will:

(A) By feeding experiments on the mother (1) during pregnancy, (2) during lactation.

(B) By feeding experiments on the offspring as regards both temporary and permanent teeth. And they state that vitamin D (activated ergosterol) is the necessary factor to induce retention of calcium and phosphorus and make good teeth.

As sunlight is necessary for the production of vitamin D, either directly in the body or vicariously by way of the food, the claim is justified that *light* is *the* essential factor in good bone and tooth formation (see "Purdah System and Its Effect on Motherhood," Heffer, 1928), and hence that the *indoor life* is the chief cause of defective calcification both in tooth and in bone.

In all countries and districts where teeth are good the life is an open-air one with simple food; the food, of course, varies in different places and under different conditions, but the free open-air life is a constant factor.

Now the ætiology of dental caries until lately was obscure and many ingenious and contradictory explanations were put forward.

Bad teeth have been put down to race, mixture of race, heredity, civilization, age, occupation, blood groups, internal gland secretions, exanthemata, acidosis, alkalosis; to food, to water, excess of salt, no salt, sugar, no sugar, cereals, no cereals, absence of vitamins, especially D, to poverty, to riches and luxury, to neglecting to clean the teeth, invasion by specific bacteria. These are all modern ideas.

But the Chinese said worms, the Kashmiri still says "a worm is eating my tooth," and Aristotle said—figs.

Most of these explanations have also been offered to account for the incidence of rickets and osteomalacia and difficult childbirth, and this is a testimony to the fact that dental hypoplasia and caries, rickets and osteomalacia, are undoubtedly different manifestations of the same condition, failure of the process which normally stores and utilizes calcium and phosphorus in the teeth and bones.

I am much indebted to Graham Macphee's book, "Dental

Caries,'' 1935, which gives an up-to-date summary of this problem.

Bearing in mind that this question only concerns us here in its relation to our present obstetric problem, let us look at some of the facts he gives us.

He remarks that teeth, being part of the living body, are healthy or the reverse as the body is well or ill.

Prehistoric skulls show no caries, though the teeth may be worn away. Colyer, 1933, states he knows of no skulls of prehistoric man that show caries. The Roman invasion, with its more luxurious life, produced caries, as shown by the skulls of the period. When the Romans left England and civilization relapsed we again find good teeth in the skulls.

The poorer classes in Egypt *until modern times* were immune, but it became common as people learned luxury (Sims Wallace).

Deciduous teeth were immune in Egypt (this would appear to be the case to-day in Kashmir), due no doubt to the open-air life, much sun, and the nakedness allowed by custom to the children.

J. R. Mummery (*Trans. Odont. Soc. of G.B.*, 1869) made a most complete investigation—and found Maoris, Esquimaux, and coastal North American Indians had the smallest incidence of caries and that they lived on a diet of flesh and blubber.

Among the hill people of the Himalayas, who are mostly Hindus and the diet is vegetarian (meat for religious reasons not being eaten), they have perfect teeth. The Mohammedans of the same regions, with a different dietary including meat, also have perfect teeth, *provided they follow an outdoor occupation.*

It has been suggested that the Esquimaux on a meat, blubber, and fish diet in which vitamin D is in excess thus compensates for the over-clothing and the long dark winters when the sun is below the horizon.

In Tristan da Cunha the diet is chiefiy one of potatoes, fish, milk, and eggs, all soft foods, and the islanders never clean their teeth. Perfect teeth and no difficulty in childbirth are found.

In the island of Lewis the infants are said not to be taken out until they can walk, and yet teeth are good and rickets unknown. Windows and doors are open or absent. The children are breast-fed by mothers who are out all day long, a case illustrating the

truth of Luce's experiments on the antirachitic value of milk produced by cows in the open.

It would be interesting to know the latest dental report on Lewis now that indoor school life is being brought "up-to-date," for, to quote from the *British Medical Journal* of December 28, 1929, in a report of a debate on Highlands and Islands Additional Grants Bill, we read: "In regard to dentistry, Mr. Macquisten said the late Dr. Donald Murray had told him that fifty years ago every youth of seventeen in Stornoway had a sound set of teeth, whereas now it was impossible to find one whose teeth were not decayed."

In the Carnegie Trust Report on Maternal Mortality, if we read carefully, we see that in those places which have *no deaths* in childbirth the elders have *perfect teeth*, and there is no rickets among the children. We learn further from the same report that the beginning of school life in the Outer Hebrides, with its confinement indoors and the calling of the grocer's van, which provides jam and white bread, is causing both rickets and dental decay among the younger generation, and in the same areas difficulty in childbirth is beginning to be common.

In India, too, we have introduced schools on Western lines (indoors), whereas the traditional Indian school is held out of doors under a tree, and the young people now begin to suffer from bad teeth.

J. C. M. Shaw states: "In their native state the Zulus have exceptionally fine teeth, but once they emigrate to the towns they at once develop caries." He describes 600 native school children with as great an incidence of dental caries as obtains in England, but he does not tell us the connection between the hours spent in school, the miserable native quarters in which they lived, and the poor food forced upon them by town life with the incidence of dental caries among them.

"While it is thought that dental caries may result from any excessive drain of calcium, it is also sometimes an indication of general bodily debility.

"An increased incidence of dental caries is frequently observed during or after an illness. A certain experienced dental surgeon, on finding any of his patients with an unusual number of cavities, used to ask if they had been ill, and nearly always found that

they had. The teeth may thus be regarded as an index of bodily well-being, a delicate barometer of health.'' He quotes Eames, 1899: ''General diseases . . . with resulting vitiated secretions, must be considered as concomitant causes of decay'' (Macphee).

I should be inclined to consider the cause of decay during and after illness as due to the confinement indoors, like the case of the Chinese youth who developed osteomalacia as the result of thirteen months' illness with confinement to the house. The Report of the Director-General of Public Health, New Zealand, 1931, shows how modern conditions have affected the Maori of to-day by introducing the more restricted life and the school (pp. 20-21). We find in an examination of school children drawn from ''groups of Maoris in different environment—a large percentage living near the sea coast and living lives modified accordingly.'' Of 363 Maori children examined, 35·0 per cent. had dental caries, while 53·7 per cent. of a group of 363 of the European children were similarly affected. One would expect trouble in childbirth to be increasing among them proportionately, and, according to Dr. Paget, they have now great difficulty in parturition, the mortality rate among those who do not adopt European methods being double that of Europeans, and states that the caries rate in Maori children in some districts is even greater than in European children.

This report also tells us how common tuberculosis, cancer, goitre, trachoma, dysentery, influenza are among Maoris nowadays. As I pointed out (*B.M.J.*, May 12, 1934), ''the one civilized disease they do not have is appendicitis, doubtless because they still squat.''

These facts seem to me to show the essential connection between civilization, caries and difficult childbirth, and emphasize the contrast between modern life and the old régime when education indoors was unknown.

H. P. Pickerill, 1914-24, reports that only 0·76 per cent. of the skulls of uncivilized Maoris showed signs of dental caries, while in the modern civilized Maoris 95 per cent. were afflicted with the disease. He attributed the change to diet (from ''Dental Caries,'' Macphee). I should attribute it to a confined life.

Among all savage races dental decay is unknown, but begins immediately liberty is curtailed; for example, when they are

obliged to live in a reserve, or are employed in towns, or work in coalmines where their bodily activities are limited and the necessary sunlight on the skin further reduced by the white man's clothing. They suffer, too, from eating his white bread and jam and his overcooked, poor foods, from his methods of education, which tradition decrees must be conducted indoors, so that those hours of sunlight, so natural and so necessary to all young and active things, must be spent cramped up indoors with books.

In Kashmir the boat women have perfect teeth, but the Zenana woman, living entirely indoors and never going out, suffers from dental caries and pyorrhœa.

The teeth begin to decay directly the little girl leaves her playing outside in the open air and is shut up at eight or nine years old. The richer boys begin to have carious teeth also in proportion to the amount of time they spend indoors at school, just as in England the intensive study period is accompanied by tooth decay.

Does not the same thing apply to domestic animals? Pet dogs, such as Pekingese, kept always indoors, have dental trouble, and also much trouble in parturition, while the teeth of the wild dog, such as those who used to run about the Kashmir streets, are lovely in their natural, gleaming, polished state. (A dog's tooth is used as a burnisher by the wood carvers, so hard and smooth is it.)

In spite of many recent statements that diet alone can control the state of the teeth, I am convinced that food plays only a secondary part; sunlight is the essential factor, for the want of vitamin D in food can be made up by the action of sunlight on the skin, but unfortunately present-day ideas demand the education of children indoors. Disease (caused by this unnatural life) has to be counteracted by doses of cod liver oil, halibut oil, and artificial substitutes to replace the natural vitamins made by the sun, of which we ingeniously deprive them by making them live indoors.

We notice again and again in a family how the child who goes out freely and indulges in outdoor sports has good teeth, whilst one who is delicate or ill and is kept indoors, perhaps in bed, will suffer from caries, and later on from pelvic insufficiency. It is the custom to attribute the bad teeth to the illness rather than to the true cause, the life indoors, with deficiency of vitamin D.

Until recently our English canal boat people were remarkable for their good teeth and for large families born with no trouble, neither doctor nor midwife being available. No school for the children.

Macphee, in summarizing his subject, agrees that perfect teeth are found commonly among those working out of doors on a natural and sufficient diet without luxury. It is very instructive to note among those with the best teeth the complete absence of the toothbrush. A Welsh girl with perfect teeth asked how she cleaned them, said she rubbed them with a bit of flannel.

All Eastern people rub the teeth daily with the fingers, and after a meal rinse the mouth thoroughly, driving the water through the shut teeth to cleanse them thoroughly from the least particle of food. A banquet is incomplete without provision made for each guest to do this. In the houses of the rich, handsome chased ewers and bowls with ornamental perforated metal gratings are brought round to each guest in turn by the servant, who carries an embroidered towel over his arm.

The importance of perfect teeth at puberty cannot be overestimated from the obstetric point of view, for they negative any idea of rickets and therefore give reasonable expectation of the round pelvic brim and an easy confinement.

Teeth and Athletic Success.—For some years now I have noted the pictures of winning teams at university and other sports. They all have well-developed jaws and good teeth, as significant in the athlete as in the case of the successful mother, because of the positive indication they give of good skeletal development and absence of rickets. Contrast the faces and general development of the university crew with that of the cox. Dental surgeons in university towns could give us chapter and verse for this.

CHAPTER V

THE PELVIC JOINTS

HERE we reach a debatable subject on which opinion is still divided. Are the pelvic joints true joints, and do they separate in labour to allow the passage of the fœtal head, and if so how much expansion is thus permitted?

In all mammals the pelvic joints play an important part during parturition. The ligaments soften, the articulations consequently become more mobile, and the three components of the pelvis, the sacrum and the two innominate bones, are less firmly welded together, so that there is appreciable space between them. The farmer knows when his cow is going to calve because "the rump falls." In other words, her sacro-iliac joints loosen and the sacrum drops between them. In the mare the same thing happens; in the guinea-pig its little pelvis, which could not possibly let the head of the young through in its ordinary state, separates at the symphysis more than an inch before parturition takes place.

In the seal, the separation of the pelvic bones at the symphysis is more than five inches, and there is no mammal whose pelvic articulations do not loosen and separate to make birth easier for the mother. We note, too, that the animal instinctively gives birth in that position which makes full use of this expansion at the joints, so that they may be drawn apart by the muscles as far as possible to make room for the passage of the young through the pelvis.

The problem of the pelvic joints is of prime importance in obstetrics, yet text-books in this country and in America pay little attention to the matter. The ancients looked upon the sacrum as the most important part of the spine because of its function in childbirth, considering that it acted as a swing-door, thus permitting the passage of the child, and the name of sacrum—the sacred bone—was given to it. The sacrum was a sacrificial bone in ancient times. Among the Jews there is a tradition that neither fire, water nor blows can destroy it—that it is the indestructible nucleus of resurrection.

Hippocrates, in the fifth century B.C., as well as Galen and Soranus in the second, A.D., taught that during parturition the pelvis gave way at the joints and let the child's head through just as it did in animals. This opinion was held by all the great authorities for over 1,500 years, although Vesalius in the sixteenth century considered he had proved that it was impossible.

Paré (1510-1590) described a case in which crepitation was felt on laying the hand on the sacrum of a woman in labour, and he taught that its mobility was an important factor in every labour, a view held by French anatomists up to the present day with but few objectors. Anstruc in 1766 described separation of the pelvic bones in difficult labour, but stated that this was uncertain as it only occurred in *young* women. The whole subject was fully dealt with at the Gynæcological Congress, Amsterdam, in 1899, when Bonnaire, of Paris, and Bué, of Lille, read a paper on change in size of the pelvis due to posture, which was followed by a discussion in which most of the leading obstetricians of the day took part.

It was pointed out that the pelvic joints undergo relaxation during pregnancy, and that this relaxation begins with the hyperæmia and swelling of the synovial membranes, cartilages and ligaments of the joints. Lushka (1820-75) was quoted as having already noticed this softening of the synovial membranes during pregnancy, and he had demonstrated the presence of a cavity in the fibro-cartilage of the pubic symphysis, and therefore classed it as a true joint, claiming that by suitable movements of the pelvis a definite enlargement of both antero-posterior and transverse diameters could be obtained *in every pelvic plane*.

Budin showed that an up-and-down movement at the symphysis could be felt in a pregnant woman by placing a finger on the bones as she walked, and it was stated that there is a similar relaxation, but less in degree, at the sacro-iliac joints, the lower parts of which can easily be felt in the case of women who have borne many children. There is, too, a loosening of the intervertebral joints in the lumbar region, which accounts for the lordosis so characteristic of the pregnant woman.

It had been observed by Barlow that during pregnancy the sacro-sciatic ligaments in animals, such as the cow, became both

thicker and longer to allow for the increased mobility of the joints.

Bonnaire and Bué stated that the views of Hippocrates (which had been accepted without question until the eighteenth century), according to which the pelvic articulations relaxed enough to allow the bones to separate from one another during labour, only required slight modification to bring them into line with modern ideas, but that the degree of joint relaxation varies with each individual, and will be more pronounced in a woman who has had many children than in a primipara.

Bar agreed with this, and pointed out that the laxity characteristic of pregnancy is increased by multiparity, walking, working in a standing position, carrying burdens, and also by conditions causing increased size of the uterus, such as twin pregnancy, hydramnios, a big child, or a tumour complicating the pregnancy. He notes that the mobility can be tested by seizing the iliac crests while the patient walks, for at each step movement can be felt. He, too, had studied the mechanism of enlargement of the conjugate in the Walcher position, and in 1894 had shown that during the lowering of the pelvic inclination, which takes place in passing from the ordinary dorsal decubitus to that in which the legs are hyperextended, there is first an increase in the lumbar curve, and, secondly and more important, the turning downwards of the iliac bones on the fixed sacrum. The tension on all ligaments is increased, while the extension produces movements of the innominate bones so that the pelvis becomes larger, but this increase ceases when the lumbar curve reaches its maximum, because then the movement becomes one of the vertebral column and no longer one affecting the component parts of the pelvis.

Crouzat, working on the cadaver in 1881, obtained an increase in the conjugate by hyperextending the legs, and later on Walcher in 1891 employed this method in dealing with cases of contracted pelvis in his own practice.

This position used by Crouzat and Walcher is the same in principle as that advocated by Melli in the fifteenth century, and shown in woodcuts of the time.

The nutation and counter-nutation of the sacrum which normally takes place in childbirth was described, and it was shown how it depended upon the relaxation of the pelvic joints.

The lengthening of the true conjugate, which could be obtained by posture, was estimated as ½ to 1 cm.

The next point to be discussed was the gain made in the *outlet* by the employment of the lithotomy position, and Bonnaire and Bué described the counter-nutation of the sacrum which takes place when the thighs are raised and the symphysis with them. This movement separates the ischial tuberosities from one another and thus increases the transverse diameter of the outlet of the pelvis by as much as 2 cm. or more.

It was stated that this position is advantageous in dealing with cases of funnel pelvis.

Now the points that concern us here are that the members of the Congress with but one or two exceptions were all agreed (*a*) that the pelvic joints softened and became more mobile during pregnancy, (*b*) that the sacro-sciatic ligaments became thicker and longer, and (*c*) that the pelvis itself was capable of expansion during delivery, one speaker going so far as to speak of the moulding of the *pelvis*, which he stated took place in every labour during the passage of the child's head.

Engelmann said, in 1882, he had found in a study of labour among primitive peoples that the plan well known to some tribes of suspending the woman under her armpits had a sound scientific basis, and that other postures, such as squatting and kneeling, were commonly used because of their effect in adapting the size of the parturient canal to the fœtal head, and it was stated that the squatting position for delivery was the oldest known, and was used by the Greeks and now by Asiatics, Abyssinians and Indians; that inertia during parturition was often due to the use of the dorsal decubitus, reference being made to the analogous actions of micturition and defæcation, which could not be properly performed when lying on the back, and that was why women when they felt the head coming liked to squat over a chamber or closet seat, instinctively adopting a position best adapted to the performance of an act of excretion.

And yet modern obstetricians still take opposing views—to quote only two authorities. Whitridge Williams says of the sacro-iliac joints: "These articulations possess a certain amount of mobility which plays a not unimportant part in practical obstetrics."

While Professor Jarcho, in "The Pelvis in Obstetrics," 1933, speaks of the idea that the pelvic bones separate during labour as a "false conception of pelvic pathology that persisted 1,500 years, and was a definite hindrance to the development of scientific obstetrics," and adds very decidedly, "The pelvic joints are fixed. The ligaments cannot stretch."

More and more has this view of the immobility of the pelvis come to be accepted, because among the civilized who have their hips bound up from infancy, whose every movement is regulated from birth, squatting, crawling, and climbing being prohibited or checked, the pelvis has become to all intents and purposes a rigid ring of bone, so that the softening and pliability supervening during pregnancy is met with an endeavour to prevent it by the imposition of a "surgical corset" designed to ensure perfect rigidity. The stiffness of these joints in the over-civilized is well known to all accoucheurs, for in labour the usual cry of the mothers in the West is, "Oh, my back!" because the child's head, as it advances, tears apart and stretches open the stiffened articulations. This is a cry not heard from an Indian woman, because all her joints are in constant use, which keeps them supple and elastic so that they are able to give easily without tearing as she gives birth to her child.

Doubtless the custom in the East of marriage at puberty or soon after is founded on age-long observation that at that time the pelvis is still flexible and will stretch widely during childbirth. I have seen labour in a Hindu girl of fifteen or sixteen begin with a fœtal head bulging over the pelvic brim. One anticipated difficulty, and yet if time was given it ended normally, no doubt due to the moulding of the infant's head, but *much more* to the elasticity of the mother's young and still partly cartilaginous pelvis.

Dorland and Hubeny state: "With the accumulated evidence now available, it may be positively stated that a decided alteration in the pelvic articulations does occur during pregnancy, this alteration consisting in a softening of the inter-articular substances and an actual widening or separation of the pelvic joints, notably of the sacro-iliac synchondroses."

One of the most recent papers on the pelvic joints is that by Ralph Brook, 1934. In speaking of the sacro-iliac joints in mammals, he points out how there is a direct relationship between

the freedom of movement in this joint and the activity of the animal, and that the upright posture leads to loss of mobility, and so in man the joints are less movable than they are in the higher apes.

He considers that the sacro-iliac joint is of the di-arthrodial type in the young, and that as age advances its character is completely altered in the male and less completely in the female. He states that in the middle-aged of both sexes it is an amphiarthrosis, while in the male of later years it is a synarthrosis.

At the advent of puberty, secondary sexual differences appear. In the male the amount of movement does not increase, if anything it diminishes, as he well puts it, mobility is sacrificed to strength, but in the female from the onset of puberty to the age of twenty-five a rapid increase in mobility takes place and at twenty-five maximum mobility is attained, strength and solidity being sacrificed in her case to increased mobility, the ligaments and soft parts of the joint remaining comparatively lax, an adaptation to function, "the probable and natural female function of parturition."

He continues by showing how sacro-iliac disorders are more common in the female and how in her, movement diminishes from twenty-five to fifty years of age, and more rapidly still in the years between fifty and seventy-five, although even at this advanced age there is considerable movement.

By contrast, in males over fifty, 86 per cent. of their sacro-iliac joints are ankylosed. It is uncommon to find bony ankylosis in the male under forty, though absence of movement is common, and, he adds, ankylosis, bony or fibrous, is a characteristic of middle and advanced years; and the change, which is a retrogression, microscopically bears a marked resemblance to the condition in birds, whose sacro-iliac joints are immovable and are classed as synchondroses.

Furthermore, pregnancy increases the already greater mobility in the female, and at full term it is *two and a half times above the maximum* degree present in the non-pregnant woman of the same age.

After parturition the joint slowly returns to its normal state, and he says that the changes in the pelvic joints go hand in hand with the change in the uterine muscle, delayed involution

does take place much more easily *during labour* if the head has descended early into the pelvis, so that we may look upon the rising and descending of the head which takes place in the pregnant woman who squats daily, as a preparation for the final moulding of the infant head which will take place during parturition.

It is a reciprocal action between mother and child—for while her pelvis stretches open at the joints, as she assumes the squatting posture, the fœtal head accommodates itself as it descends into the cavity, for it is pressed together at the sutures, which are thus made to overlap. It is as if (to use a simile from the making of a garment) the pelvis is let out at the seams while the child's head is taken in at the seams.

Partridge also points out that in cases of easy but very rapid delivery the head may sustain injury—because it is not fully flexed—and if the head passes through the pelvis in the occipito-frontal position rather than the suboccipito-bregmatic, it is liable to suffer from tentorial tearing, and she states that the deaths of half the infants alive at the beginning of delivery and born dead to healthy mothers are due to inadequate flexion of the fœtal head.

This shows that the fœtal head can stand great compression in the suboccipital-bregmatic provided it is evenly distributed, but it is unequal compression of the head by the oval pelvis whose very form conduces to mal-presentation that is so dangerous and fatal.

For, as we have just seen, the head in the suboccipital-bregmatic packs up at the sutures, probably as much as the mother's pelvis opens at the joints; not only are the pelvic joints necessary to normal parturition, but their condition determines the shape of the pelvis in its final form (see p. 42, Fig. 21).

It is reasonable to suppose that as certain races who use their joints freely from birth have round pelves free movement is necessary to perfect development—hence the importance of healthy joints from infancy. The joints are kept in health by movement.

We have negative evidence bearing on this point when we consider the varied forms of mis-shapen pelves.

Naegele collected thirty-five specimens of obliquely contracted pelvis, in one from an Egyptian mummy, in which he describes synostosis of the sacro-iliac joint on the affected side, where the ilio-pectineal line, instead of being curved, was nearly straight,

and the symphysis was displaced towards the healthy side, thus causing lengthening and obliquity of the conjugate, the sacrum being pulled over to the affected side.

There has been dispute as to whether defect in the sacrum is the primary cause of the change of pelvic shape or whether it is due to joint trouble. The latter view seems most probable when we recall the Zulu girls whose pelves became asymmetrical, simply due to peculiar posture which entailed disuse of one joint.

All joints affected by rachitis are tender and therefore liable to be restricted in their movements, as we see when we watch a rickety child beginning to walk and note how rigidly the back and sacro-iliac joints are held. If he falls he screams because of this joint tenderness, and he has difficulty in picking himself up again because it is painful; the whole scene is in striking contrast with the behaviour of the normal healthy baby who falls without fear and is up again in a minute.

Michaelis gives it as his opinion that whenever the conjugata vera measures less than 8 cm. in the adult, one should suspect rachitic change.

Whitridge Williams states that in the funnel pelvis, so common in America, he has found even slight cases to be accompanied by rachitis, and he *suspects the sacro-iliac* joints.

In line with the view that many pelvic deformities are traceable to rickets, he cites the true dwarf pelvis which is characterized by the persistence of cartilage at the epiphyses.

In one case of dwarf pelvis in a woman of thirty-one (cited by Boeck) the Y-shaped cartilage at the acetabulum was present and the sacral vertebræ were not yet fused.

In the cretin pelvis unossified cartilage often persists.

Ankylosis or even mere *stiffness* or disuse of the pelvic joints can change pelvic shape, and if one sacro-iliac joint only is affected it is *that side* of the pelvis that remains undeveloped, the natural curve of the ilio-pectineal line is spoilt so that deformity results.

This should be enough to impress upon us that mobile pelvic joints are essential factors in the development of normal pelvic shape.

I shall speak later of the value of pelvic development to the athlete as to the future mother, but I now go on to consider the

integrity of the pelvic joints as essential to the proper performance of normal parturition, because by their movements the area enclosed by the pelvic walls can be increased.

There are two other movements of the pelvis besides the expansion at the three joints. I refer to the rotary movement at the sacro-iliac articulations and the angular expansion of the pubic arch at the symphysis. I shall here quote from a paper prepared by me at the request of Professor Réchou, of Bordeaux, giving a summary of the research he gave permission for me to carry out at St. André, Bordeaux, in 1933, when I had placed my views before him.

I must express my gratitude to all concerned, especially as the department was just about to be reorganized, and the electrical engineers were already busy.

With the kind co-operation of Professor Wangermez, we made a number of X-ray studies of the pelvis, and although there were technical difficulties to be overcome, we could see that the pelvis does really enlarge in the squatting position, and so encloses a larger area within its walls.

This change is more easily seen in young children than in the adult, and it is this expansion that leads to good pelvic development in the growing child while it provides the natural mechanism which makes childbirth easy.

Now everyone must have noticed the difference, when looked at from behind, between the appearance of a boy standing on tiptoe with arms stretched above his head preparing for a dive, and the same boy in the squatting or crouching position, the attitude in which healthy children love to sit and play with their toys. The first attitude gives the pelvis a slender appearance, the latter a much broader one.

As it is difficult, if not impossible to measure the change in size and shape of the pelvic cavity produced by the squatting position with an ordinary pelvimeter in the living subject (because such great changes in posture involve movement of the skin and subcutaneous tissue over the bony points beneath), we made radiographic studies of the pelvis, beginning with a profile view of a child standing upright, and then crouching. What exactly happens to the skeleton with this change of posture? In a little boy of two—our first patient—we noted several things which

helped us to understand what the crouching position does for the woman in labour. First, the tiptoe position shows us the vertebral column with well-marked lumbar curve. The body of the fifth lumbar vertebra is seen to be widely separated from the body of the fourth lumbar above it, and from the first sacral below, and the intervertebral discs, both above and below, appear wedge-shaped in profile (Figs. 30 and 31).

We next studied the same boy in a squatting position with heels on the ground. The spine is straightened, the lumbar curve is flattened out, the body of the fifth lumbar has its superior and inferior surfaces respectively parallel with the fourth lumbar above and the first sacral below, and the inter-vertebral discs look the same width back and front. The promontory of the sacrum no longer juts into the body cavity. It has swung backwards on its axis, which, as Testut tells us, runs transversely through the lower part of the second sacral vertebra.

In native races, where the sacro-iliac joints are well developed because in constant use (as chairs are unknown), there is always a well-marked depression on the sacrum, into which a definite projection of the os ilium fits, and it is upon this pivot that the sacrum swings. The longitudinal concave surface of the sacrum measures about 12 cm. from promontory to the coccyx, and this depression is about halfway down the side, 6 cm. from the top.

As has been often observed both in domestic animals and in woman, the pelvic joints are softened and loosened during pregnancy, so that this movement at the sacro-iliac joints becomes freer, and in woman produces the loose and rather lumbering gait so characteristic of the last week previous to confinement. Dr. Anderodias, of Bordeaux, kindly sent us several women nearing the end of their pregnancy, that we might make our observations upon them. In two of these women, one at term, the other at the eighth month, we measured the *external* conjugate with a pelvimeter. In both women standing on their toes the measurement was 23 cm., and when squatting 27 cm.—a difference of 4 cm. produced by change of posture alone. (To measure the increase of the *true* conjugate in the squatting position is not an easy task, but the changes in the adult woman, as observed by X-rays, were exactly comparable with those already described in the child. The lumbar angle, estimated as 120 degrees in woman, was

PLATE III

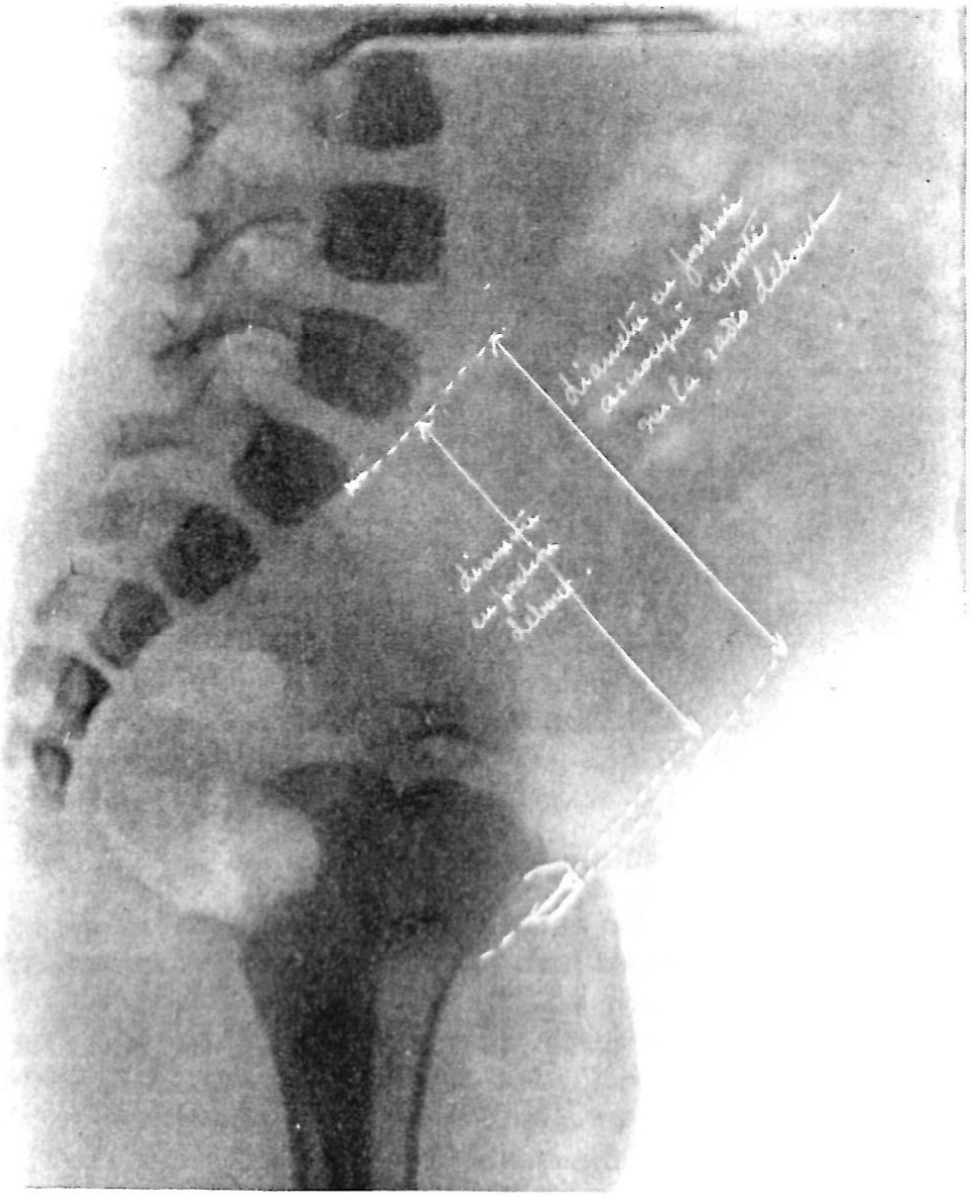

FIG. 30.—CHILD OF THREE STANDING.

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To follow page 94.

PLATE IV

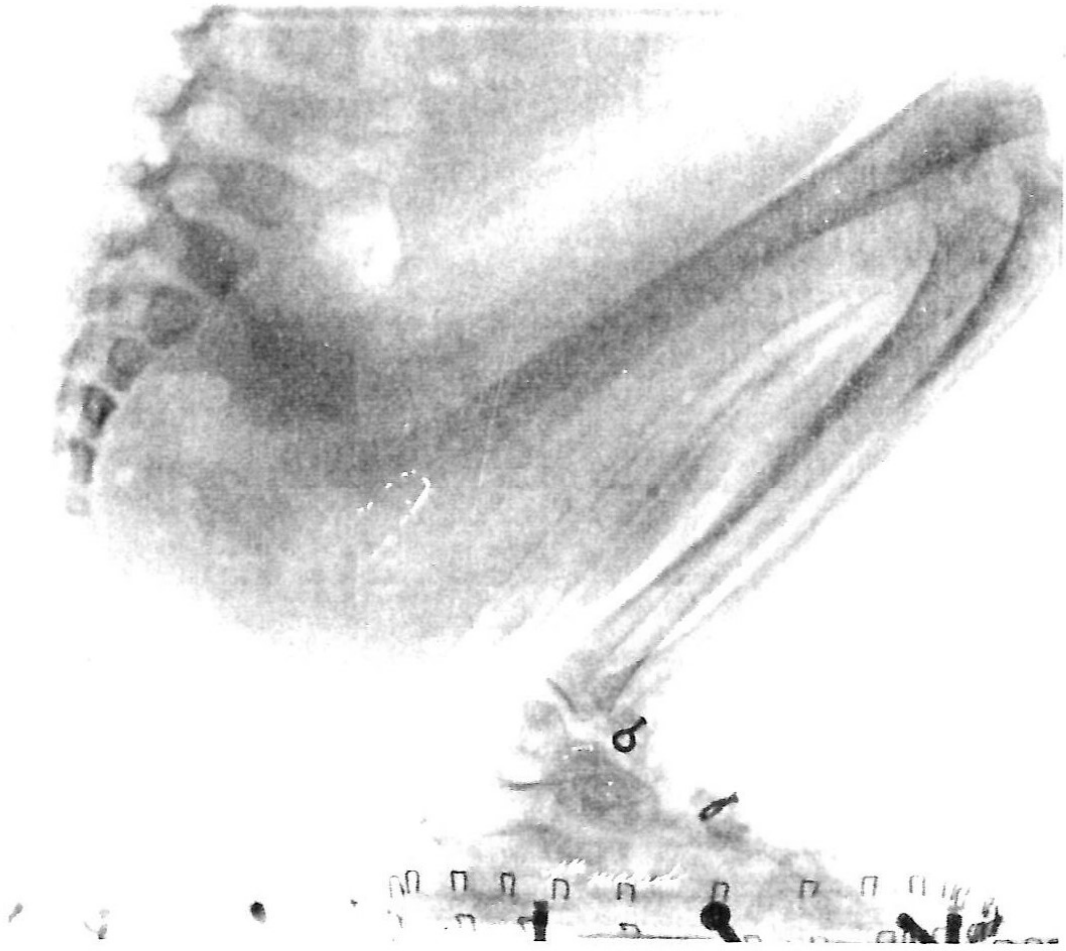

FIG. 31.—CHILD OF THREE SQUATTING.

To face Plate III.

flattened out as the top of the sacrum rotated backwards when she crouched, just as we saw it in the young boy.)

We made a great number of radiological studies, but found it impossible to measure the increase with accuracy. But we considered that we did not overestimate by taking the increase in the antero-posterior diameter of the pelvic brim (the true conjugate) gained by making the woman crouch *as at least* 1 *cm. or* 1·5 *cm.*

Later on, when staying in Arcachon, I met Dr. Rubenthaler, himself a radiologist with special knowledge of obstetrics. He was much interested in the whole subject, and we made studies of a girl ten years old in different positions: (*a*) Lying extended on the side; (*b*) lying with knees flexed on the side; (*c*) lying in a position of forcible flexion on the side.

The importance of these later studies is to be found in the exact measurement they afforded of the change in length of the pelvic brim in the crouching position—*i.e.*, increase in the true conjugate. We obtained the following results:

(*a*) Lying with legs extended, distance from pubic symphysis to the top of promontory	10·6 cm.
(*b*) Lying with knees flexed	11·05 ,,
(*c*) Lying in position of *forcible* flexion (as in squatting)	12·3 ,,

A difference of nearly 2 cm. in a child of ten.

At the outlet the distance between the ischial tuberosities was increased from (*a*) 7·9 cm. to (*b*) 8·6 cm. and (*c*) 9·1 cm.—a gain of over 1 cm.

The obstetric importance of these facts can hardly be overestimated, as the gain of even 1 cm. in the conjugate of a woman would often suffice to turn a difficult labour into an easy one. This is the reason why all native women crouch to have children. Crouching is the natural posture for childbirth, for the brim of the pelvis is then at its largest. (In a primigravida at term, we could see by means of the X-rays the descent of the fœtal head into the pelvic brim directly she assumed the crouching position.)

Now the Walcher position, with the woman's buttocks hanging over the edge of the table, also produces a lengthening of the conjugate by 1 cm., and "has proved sufficient to permit the engage-

ment of the presenting part which otherwise could not occur" (Whitridge Williams), *but it contracts the inferior strait of the pelvis at the same time.*

If it is asked how quite opposite attitudes of the legs, doubled up as in squatting and extended as in the Walcher position, can produce the same result—namely, a lengthening of the conjugate at the brim—I would point out that they both do so because the top of the sacrum swings back when the patient crouches, and the distance between the top of the pubic symphysis and the promontory is thereby increased; whilst with the Walcher position, *the same effect is obtained* by fixing the sacrum on the edge of the table when the weight of the hanging legs causes a rotation of the innominate bones downwards, thus increasing the distance between the top of the pubic symphysis and the promontory.

The squatting position really does all and more than the Walcher does, and is vastly more pleasant for the woman; the sacrum is neither in nutation nor counter-nutation, but *balanced* halfway between the two positions, going forward or back as the woman slightly alters her attitude. This movement, however, is not a simple one, for the sacrum is wider *before* than behind, *above* than below, and the movement of counter-nutation, which takes place in crouching, is accompanied by an outward thrust which separates the innominate bones from each other, stretches the pelvic floor and increases the sub-pubic angle. Separation of the knees increases these results. Anyone can feel for himself this outward movement by placing the fingers on his own ischial tuberosities as he stands. (These are the points where the movement of the innominate bones will be the greatest, and therefore most easily felt.) He will find that the hands are separated from each other as he assumes the squatting posture (see Figs. 33, 34, 35, and 43).

The movement of the innominate bone in squatting takes place about an axis passing through two fixed points, the first being the pivot in the sacro-iliac joint (lower part of the second sacral vertebra), and the other fixed point being midway between the top and bottom of the pubic symphysis. So that when the patient assumes the crouching position there is a turning of the bone round this axis (much as in the chest the ribs rise with inspiration and fall in expiration), and consequently the ischial tuberosities

rise slightly, as they move apart when the patient squats or crouches. Obviously this movement will enlarge the outlet of the pelvis. Just as in the chest during inspiration the ribs rise as the diaphragm descends, and the capacity of the thorax is increased, so in exactly the same way do the ischial tuberosities rise during squatting, and the pelvic floor, with all structures attached to it, flattens as it is stretched out, and the capacity of the pelvis is increased.

Movement at the Symphysis.—Some anatomists have described an up-and-down movement at the pubic symphysis in the pregnant woman, the bones gliding on one another. Budin says this movement can be easily felt with one finger in the vagina palpating the pubic arch as the patient stands first on one foot and then on the other. Our X-ray studies give no sign of this whatever, either in children or in the pregnant woman. The top of the symphysis remains level even if the patient raises one foot on a chair. But what really happens in squatting, and in raising one leg, is a change in size of the subpubic angle, which becomes wider. The lower part of the symphysis opens, and the anterior wall of the birth canal *shortens*. It is this angular movement, increased in pregnancy, which one finger in the vagina mistakes for an up-and-down movement of the two halves of the joint itself.

In three cases the increase was estimated as 6, 12 and 15 degrees. Verneau gives the subpubic angle as 74 degrees in the female and only 60 degrees in the male.

The result upon the pelvis of assuming the squatting position can be considered in its effects in detail upon the three planes as described by obstetricians:

(1) *The Inlet.*—This is enlarged when the movement backwards of the top of the sacrum adds at least 1 cm. to the conjugate; the transverse diameter is slightly increased also by the outward thrust of the sacrum as it goes back.

(2) *The Plane of the Cavity* is unchanged except for the stretching due to the elasticity of the articulations and ligaments, because it is measured from fixed points which cannot change their position to one another, and it is circular (Fabre, Testut). It extends from the middle of the posterior surface of the pubic symphysis to the junction of the second and third sacral vertebræ.

(3) *Inferior Plane or Outlet.*—Here we find the crouching

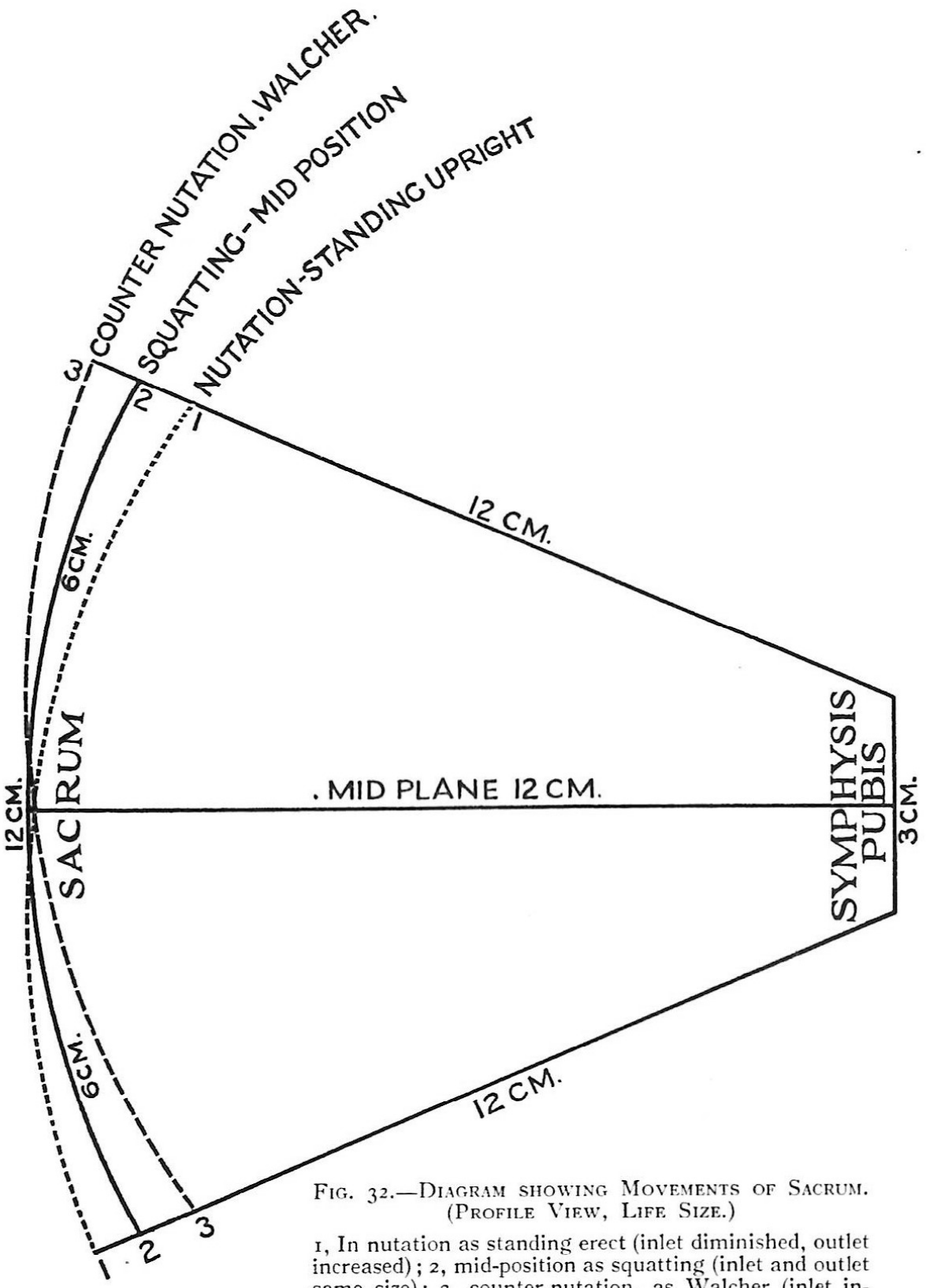

FIG. 32.—DIAGRAM SHOWING MOVEMENTS OF SACRUM. (PROFILE VIEW, LIFE SIZE.)

1, In nutation as standing erect (inlet diminished, outlet increased); 2, mid-position as squatting (inlet and outlet same size); 3, counter-nutation, as Walcher (inlet increased, outlet diminished).

position can enlarge the antero-posterior diameter (Whitridge Williams), but find the *transverse diameter* is the one noticeably increased, and we consider the transverse enlargement produced by the separation of the ischial tuberosities to be at least 1·5 cm. It is this movement which increases the subpubic angle from a right angle to 100, well seen in our X-ray studies, but difficult to compute with accuracy.

Of course, as the promontory goes backwards and increases the size of the brim, the lower part of the sacrum comes forward and diminishes the antero-posterior measurement of the outlet, but this is compensated by the transverse increase of the outlet as above described. Alone with nature, the parturient woman makes slight changes of position as the head descends, a swaying movement backwards and forwards, as those who have watched *natural* childbirth can testify, and this change of position causes a delicate adjustment of the pelvic bones as the head passes. The sacrum swings between the innominate bones, and the innominate bones swing on the heads of the femora. This explains the use of the rocking-chair in parturition as employed in Cyprus, where the patient sits over a hole cut in the seat, or as in Canada, where she kneels on the ground and adjusts herself by resting her arms on the seat of the moving chair.

It seems that the final result of the changes produced when the crouching position is assumed is to turn the pelvis from a passage of varying calibre, transversely oval at the brim, circular halfway down, and oval from the back to front at the outlet, *into a tube or canal of uniform measurements*. In a woman about to give birth in this position, the lumbar curve in the spine is obliterated, and the whole passage is converted into a cylindrical tube. This agrees with what we see in animals.

Fabre ("Traité d'Obstetrique," p. 85) says, "of the pelvis in section, the midplane has a circular form having a diameter of 12 centimetres," and adds "that between the inlet and outlet the pelvis has the form of a cylinder of which the anterior wall is wanting in its lower part."

We have seen that the pelvis can be expanded by suitable posture. It is most capacious in the squatting and crouching position, and this increase in size is dependent upon the mobility of the pelvic joints and also upon their extensibility, both these

PLATE V

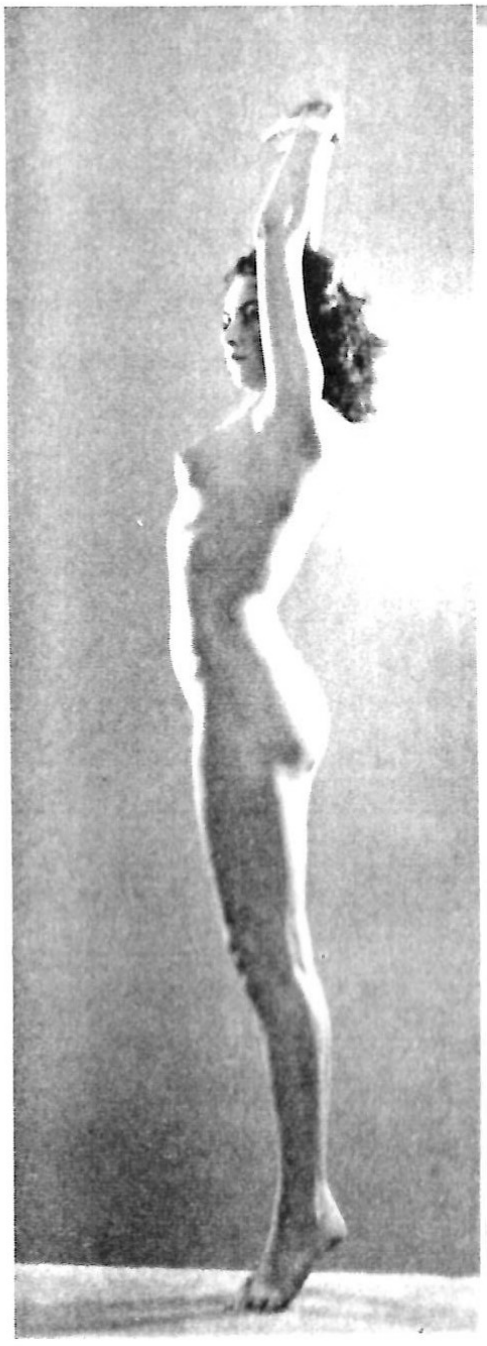

FIG. 33.

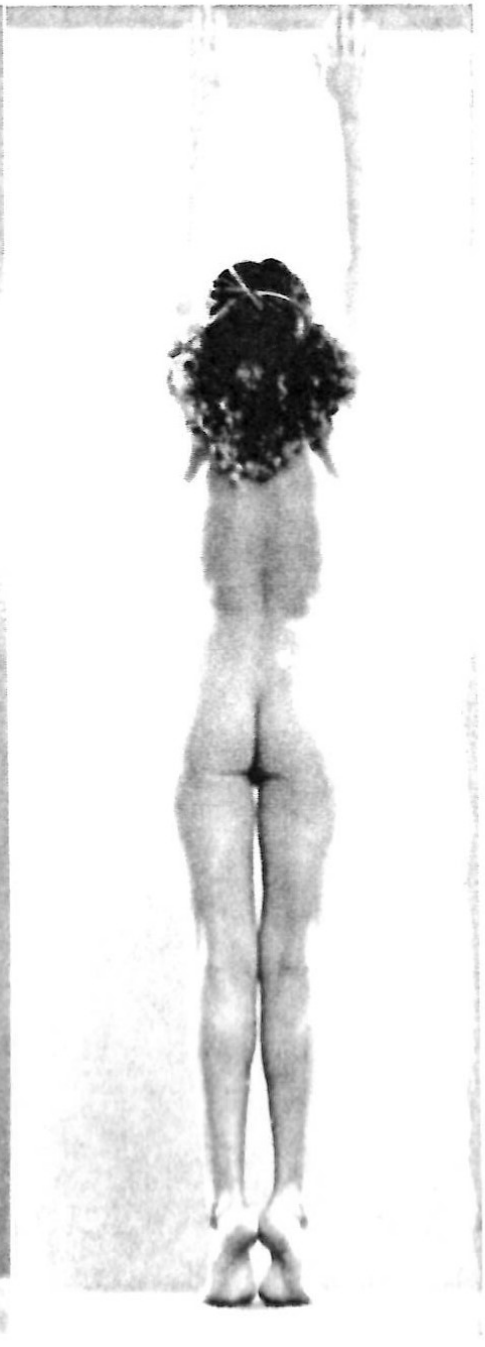

FIG. 34.

SLENDER HIPS.

To follow page 100.

PLATE VI

FIG. 35.—NOTE BROADENING OF HIPS.

To face Plate V.

qualities being more marked as pregnancy advances. This increase of pelvic area dependent upon posture seems to have been entirely overlooked both by anatomists and obstetricians, and yet it is what we might reasonably expect when we remember that the thorax and pelvis are homologous structures.

They both have the spine at the back; in the case of the thorax the dorsal vertebræ, in the case of the pelvis the sacral and coccygeal vertebræ form the posterior wall.

The ribs and sternum compose the side walls of the thoracic cage, just as their homologues the innominate bones complete the pelvic cage. When one regards the human pelvis from this point of view, one gets an idea of the sort of movements it is, or should be, capable of executing.

The chest movement which takes place in inspiration consists of a lifting of the ribs and a widening of the infrasternal angle. The result is an increase of intra-thoracic area.

In squatting this action is reproduced by the pelvis; the innominate bones lift at the same time that the subpubic angle is widened when the patient crouches.

The result of inspiration upon the chest is to increase its capacity, so squatting increases pelvic capacity.

Just as there is a negative pressure in the chest on inspiration, so squatting produces a negative pressure within the pelvis. (This is made use of by gynæcologists in the knee-elbow position.)

As variations in intra-thoracic pressure stimulate circulation in the lungs, so variations in pressure are accompanied by circulatory changes in the pelvis. The contained organs—rectum and bladder, uterus or prostate—are alternately engorged and depleted by this suction action. Absence of pelvic movement consequently causes both pelvic and abdominal stagnation, and is probably the starting-point of the commoner diseases of the civilized, who cultivate the rigid pelvis. I would instance appendicitis, gall bladder trouble, constipation, and the stagnation of secretion in both uterus and prostate, later followed by fibroid degeneration.

Nearly all civilized people live with the main drain blocked up. Their bowels are full of germs and the products of decomposition *because it is impossible to fully empty the bowel without squatting.*

Do not these simple considerations explain the connection

between appendicitis and constipation and show us why auto-intoxication is so common? It may explain the increasing prevalence of malignant disease in the civilized and its rarity or absence in natural man.

Young Indian princes with English guardians are often taught European habits of the toilet. Whereas appendicitis is unknown among their subjects, they frequently develop it after they have been "educated." As regards enteric fever, the squatter has it lightly or *not at all*, for the infecting germ has no chance to stay, driven out by the crouching position assumed several times a day for both urination and defæcation, whereas it is common and often fatal in the more civilized, whose pelvis is rigid, and therefore excretion is never complete.

Consider, too, the cause of so-called congenital hernia. It is contracted *after* birth, when the nurse succeeds in making the child pass its motions upwards while she holds its feet together in the air to change its napkin. The pelvis is then in the most contracted position, the hernial openings are unsupported at the same time that needless effort is expended by the hapless infant, who, unable to expand its pelvis in the natural process of defæcation, struggles to empty its bowels and void its urine against the force of gravity. Much better is the Indian mother, who carefully doubles up the legs of her new-born against his chest and holds him in a crouching position.

Probably the worst obstetric difficulties are to be met with in Americans, *who never squat*, and have stiff pelvic joints because they sit for hours in their homes and in cars, and so develop the funnel pelvis, the direct result of checking its natural expansion.

All over the world, where there are no closets, so that squatting is an ordinary daily practice, there the women have little trouble in childbirth: the male and female births are approximately equal, cases of congenital mental defects are rare, and the general population are free from many of the diseases common to civilization.

As to childbirth, which was the prime object of my inquiry, we now understand why all women left to themselves have their children kneeling, crouching or squatting, because in this position the pelvis is in fullest expansion, and so gives more room for the passage of the child.

CHAPTER VI

POSTURE IN CHILDBIRTH

LET us recall once again the three essential conditions for normal childbirth:

1. Round brim.
2. Flexible joints.
3. Natural posture.

But the patient probably presents herself to the obstetrician with an oval pelvis and stiff joints. Neither the shape of the pelvis nor its flexibility can be altered at the last moment, but posture, the posture in which she is to be confined, can be chosen and made use of.

What, then, *is* the best posture in which human parturition can be accomplished?

I am much indebted to Dr. G. J. Engelmann's book, "Labour among Primitive Peoples," 1884, for a masterly review of the whole subject of posture in childbirth. He was first attracted to the study by seeing a small funeral urn with an ancient Peruvian labour scene depicted upon it, in which the woman is squatting in the arms of a figure behind her, and the midwife at a lower level receives the child's head as it is born, one of the oldest labour scenes in the world, and curiously paralleled by the snapshot reproduced on Plate VII., facing p. 115, of the posture for childbirth used to-day in Nigeria, sent me by Dr. Stephens, of Ilorin, Liberia.

Of interest in another part of the world the British School of Archæology in Iraq, in their official report (April, 1935, p. 79), describing models of human figures found at Arpachiyah, say that they are mostly females and represent "mother goddesses" (date about 4000 B.C.): "Most interesting is the consistent attitude in which these figures are represented; it is almost always the squatting position," and it is pointed out how in the Middle East and in other parts of the world the woman gives birth "in the squatting position," and that the connection of these figurines with fertile childbearing is beyond dispute. The Egyptian hieroglyph for

woman represents the child issuing from her body while she sits on her heels.

A larger volume, "Histoire des Accouchements," by G. J. Witkowski (1887), quotes much of Engelmann's work, as does a

FIG. 36.—PERUVIAN POTTERY SHOWING METHOD OF CHILDBIRTH. (ENGELMANN.)

recent volume by Julius Jarcho (1934), who has brought the subject up to date with valuable original observations of his own.

Engelmann says that, according to Homer, Aurora typifies the woman in childbirth, and she is represented with scissors as a midwife, and is surnamed "the Kneeling" because she gave birth . . . kneeling, a position which was supposed to make parturition easy. The women cried to her in their pains just as

at this day Indian women cry to Hari Ram, and Polish women to Santa Maria in similar circumstances.

The midwife is first mentioned in the Bible, Gen. xxxv. 16, 17, where Rachel's labour was hard, and the attendant said to her, "Have no fear, for you will bear a son," which she did, and then died.

We find that the mother of Moses delivered herself, evidently with ease, and the midwives told Pharaoh, when he reproached them for not obeying his orders to destroy the male infants of the Hebrews, "The Hebrew women are different from the Egyptian women, for they are strong and are delivered before

FIG. 37.—HIEROGLYPH EXPRESSING IDEA OF CHILDBIRTH. (WITKOWSKI.)

the midwife can get to them." An example of the hard-working outdoor woman having an easy labour, while the luxurious woman's confinements were prolonged.

Old representations of the birth of Buddha describe his mother as having seized the branch of a tree and so being delivered (Peshawar Museum).

From Menascha, "Childbirth amongst Ancient Egyptians," we learn that the most ancient hieroglyph for birth shows the woman kneeling, while the most recent shows her squatting with knees apart and her hands upon them. (Much of the matter and several illustrations are taken from a paper by Sir A. R. Simpson.)

There is a well-known sculpture from the temple at Esneh showing Cleopatra being delivered of an infant. She is kneeling, buttocks on heels, arms above her head, clasping a woman standing behind her while the midwife crouches in front.

Engelmann quotes from Dr. N. Kauda, of Tokio, who describes the confinement of the Japanese woman who kneels during the process, her body supported on the tips of the toes and knees, the same position as that used by Cleopatra.

Tradition states that the Mother of Christ was delivered on her knees.

The Thibetan woman to this day seeks the company of the cattle when about to give birth, and is delivered by herself, alone in the stable where they are stalled, and so are many Hindu women among the agricultural classes, for the Hindu woman must be confined according to religious usage which prescribes a ground floor room with earthen floor; both birth and death must

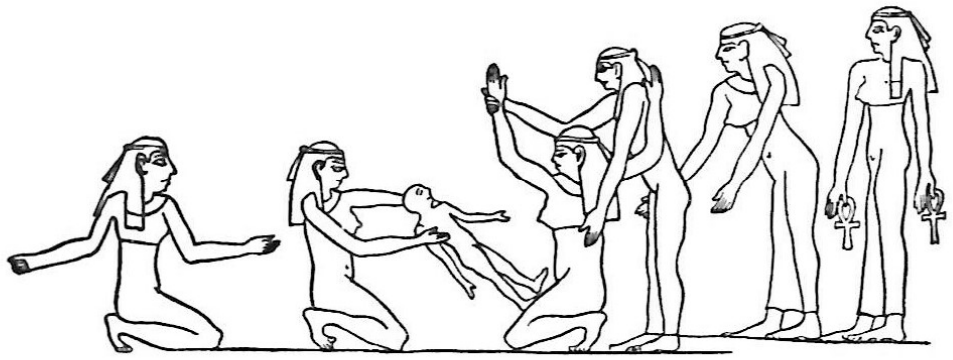

FIG. 38.—CONFINEMENT OF CLEOPATRA.
From a bas-relief in the Temple of Esneh. (Witkowski.)

take place on the ground, because Earth is the Mother of all, and to her all must return.

I shall not easily forget the confinement of the wife of a well-known and enlightened Indian potentate. All was in readiness, two Indian medical men outside in the palace, three women doctors and two English nurses in close attendance. A lofty marble chamber on the top floor of the new palace had been specially prepared by washing with soap and water, then disinfectant, then sprinkled with lemon grass oil, and yet the patient attempted with the first pains to escape to a dirty airless dungeon-like room downstairs, the only light admitted through small windows high up in the walls, a place which tradition decreed was a suitable place for birth. She was prevented from executing

her purpose only just in time, and all went well, but the urge to be confined on the earth was very strong.

In the fourth Veda, the ancient Hindu Scriptures, date 2,500-500 B.C., directions are given for the woman in labour to be attended by four women "brave and of ripe age, accustomed to be present at births, and they must keep their nails short." Anyone who has practised in India knows that even now the first lesson given to women to be trained as "dais" is on removing bracelets and cutting finger-nails short, previous to receiving further instructions on how to wash and disinfect the hands.

Roman and Greek sculpture depicts birth with the mother half reclining on chair or bed, but until this more luxurious period such a posture would seem to have been unknown.

The Cesnola collection of New York has a marble group, found in 1871 among the debris of the temple at Golgoi in Cyprus, which dates from about 400 B.C. The patient is seated on a low stool with her legs apart, and she is covered with graceful draperies. General di Cesnola told Dr. Engelmann he had seen the same thing at the present day when a Cypriot midwife brought her chair for his inspection; it had no perforation in the seat, but had a ridge in the centre designed to keep the legs apart.

From "Science and Mathematics" in *Classical Antiquity* (Heiberg) we learn that Soranus of Ephesus (second century A.D.) treated of all departments of medicine in his writings and was specially famous as an obstetrician. He describes the act of parturition, which is to be supervised by a midwife with two experienced assistants. He recommends a special kind of chair with pierced seat: and, failing this, he recommends the mother to sit astride on the knees of a strong woman, and only in cases of difficult labour may she lie on a hard bed.

Artificial removal of the fœtus by means of forceps, and the destruction of the child in the womb in order to save the mother, are fully dealt with, besides excellent advice on the management of the infant when born.

The knee-elbow position of ancient times was a reversed position in which the woman had her elbows on the floor *behind* her, as shown in an Italian woodcut of the eighteenth century, and was recommended for very stout persons by Soranus himself, and was used later by Serapion and Rhazes (first half of the ninth

century). Hippocrates, Galen, Paul of Egina, and Ætius all mention it.

Similarly, the Crouzat or Walcher or position of Avicena was known in mediæval times. It is much more troublesome and less efficacious than the position assumed so easily by every native woman, who, obeying the dictates of nature, kneels down and bends her trunk forcibly backwards, resting with hands or elbows on the floor behind her. The symphysis is thus forced into a much lower plane than that occupied by the promontory, and the conjugate is lengthened.

As we have seen, the Greeks used a stool, and a Buddhist fresco, discovered in a Central Asian cave, shows a woman seated on a three-legged stool with attendant women—date about 700 A.D.

The Wellcome Historical Medical Museum in London possesses twenty-nine birth stools. The Greek stool is in the shape of a merry-thought, supported on three legs, the part at the back being used for the attendant to sit on, so that she could support the patient with arms round the body, but the most popular and widely used form seems to have been more or less like a closet seat with a circular aperture, open in front to allow of the attendant taking the child when born.

A most interesting relic of mediæval practice is the Holy Chair which came from the Spanish Cathedral in Seville and was borrowed as need arose. It had a miraculous reputation, and over 2,000 confinements have taken place safely upon it.

The Egyptian midwife to-day uses just such a folding wooden chair with pierced seat which she takes from house to house. A chair on rockers encourages the natural swing of the pelvis on the hip joints and the sacrum in its to-and-fro movements, as the parturient canal adapts itself to the descending head.

Another way of using the rocking-chair is described by Engelmann as practised in Canada, where the woman kneels before it, using the seat as a support for her arms. As it rocks towards her she strains, and as it goes away from her the pains are slowed down.

When it began to be fashionable to be attended in childbirth by men, one can understand from the manuscripts, which picture the lady on the birth stool in some disarray surrounded by her

women, that she very naturally preferred bed where she could be entirely covered up, to the exposure necessitated by the stool.

But the position now adopted of lying in bed for the confinement itself, on the back or the side, was never common except among the wealthy, until the quarrel between the doctors and midwives began in mediæval times and continued well into the last century.

For in spite of the advances made in medicine and surgery, obstetrics lagged behind. In 1750 Catherine the Great of Russia was confined on a mattress placed on the floor beside the bed; only a midwife was in attendance, and we find even Queen Victoria delivered by the "sage-femme," the Court Physician being only nominally in charge of the case.

Some delightful reading is afforded by the history of one famous accoucheur of the Hanoverian period, whose daughter conducted fashionable confinements, and, if further assistance was needed, her father was admitted to the lying-in chamber behind a screen and crawled to the bedside unobserved by the patient, to give directions as to the conduct of the case; his presence in the lying-in chamber even as late as the nineteenth century being regarded as a shameful anomaly.

But obstetrics gained when birth began to be regarded as a fit subject for scientific study by the medical profession. The midwives refused to give up their secrets to the man-midwives, as they were called in derision. What *was* this secret of theirs? I think it was *the position natural to women during childbirth*, for until then women in all countries were confined as they felt inclined, on all fours or kneeling, sitting or squatting, and this practice continues in the present day in country districts all over Europe, where women attend to themselves or to each other. But when women took to their beds and lay down to bear children, even normal childbirth became delayed and difficult.

It was quite forgotten that the pelvis is not a cavity with rigid walls, but an expanding cage which in full expansion makes a cylindrical passage for the child. *Childbirth can be made difficult simply by adopting an unsuitable posture* in which the pelvis cannot stretch, and the infant now has to be expelled by main force and straining. To overcome this increased difficulty forceps are said to have been invented by the Chamberlens.

(They were known and used by Coranus at least a thousand years before, and we recall his wise counsel that the woman *might* lie down in case of difficulty.) But the increased space that could have been gained by posture (squatting, when the pelvic joints are stretched open to their fullest extent) was lost, and instead the forceps were employed, which took up room inside the mother and diminished the already precious space. Instead of stretching the pelvis they squeezed the child's head.

How the head bore this squeeze is common knowledge. How it does bear it to-day may be read in our latest Government reports.

Engelmann gives the following table of postures in childbirth observed within recent years by himself and others:

Europe

The dorsal decubitus, with the woman recumbent in bed, is now almost universal, having superseded the obstetric chair of the beginning of this century. Peculiar positions are still found here and there in remote districts.

France.—A standing position is occasionally assumed.

Italy.—Semi-recumbent on the lap; and in earlier days knee-elbow, semi-recumbent in bed, and erect, clinging to the neck of an assistant.

Spain.—Kneeling.

Germany.—Standing; on the lap of an assistant; partly suspended; semi-recumbent in bed, or in a sling.

Russia.—Erect, wholly suspended; squatting; kneeling; sitting erect and in the lap of an assistant.

Sweden.—Recumbent.

Greece.—Kneeling and semi-recumbent in bed, or on a low stool reclining against an assistant, in ancient Greece. In later times, recumbent in bed, or semi-recumbent on a low stool; reclining against an assistant, which appears still very common.

Turkey.—Chair; sitting on a stool.

Great Britain.—Clinging to the neck of an assistant; kneeling, arms resting on a chair or in the lap of an assistant; knee-elbow position; sitting on a low stool; squatting; sitting semi-recumbent

in the lap of an assistant (several of these positions have been frequently observed in Irish or Welsh emigrants in this country).

Asia

Kamtschatka.—Kneeling.
Mongolia.—Kneeling.
China.—Chair or bed.
Japan.—Chair; semi-recumbent, or kneeling erect on the floor.
Philippine Islands.—Standing.
Sumatra.—Recumbent.
Siam.—Recumbent; lying on the side or back.
Burmah.—Recumbent; on the back.
India.—Standing; on the lap; sitting on a cushion or stool; recumbent in bed.
Andaman Islands.—In the lap of the husband.
Persia.—Squatting or kneeling.
Arabia.—Squatting; semi-recumbent on the chair or the lap, or on two flat stones, clinging to a rope.
Palestine.—Chair.
Syria.—Rocking-chair; semi-recumbent.
Hebrews.—Semi-recumbent (on stones or a stool) and squatting.
Cyprus.—Semi-recumbent on a stool (ancient and modern).

Africa

Egypt (Ancient).—Squatting.
Egypt (Modern).—Chair.
Abyssinia.—Kneeling; sitting on a stone; reclining against an assistant or a tree.
Ethiopia.—Kneeling; standing.
Dar-Fur.—Standing.
East Africa.—Standing; sitting or squatting.
Somali.—Standing, holding on to a rope.
Wakamba.—Standing, bent over backwards.
Kaffraria.—Squatting.
Hottentots (Cape of Good Hope).—Standing.
Old Calabar.—Sitting on a chair or block.

Wazegua.—Squatting.
Canary Islands.—Sitting erect.

North America

Canada (*French Settlers*).—Semi-recumbent on the floor; back against an inclined chair.

Canada, Iroquois.—Standing, clinging to the neck.

Mexico (*Indians, Half-breeds, and Lower Class of Whites*).—Kneeling, clinging to a rope or the neck; squatting; standing and semi-recumbent on the lap and in bed.

United States (*Caucasians descended from various European races*).—Kneeling; squatting; sitting on the husband's lap; semi-recumbent in bed or on the floor, against an inclined chair; standing and knee-elbow position.

United States (*Negroes*).—Kneeling, head in the lap; squatting; suspended from the limb of a tree.

United States (*Indians*).—Mostly kneeling, clinging to a tent-pole, the body inclined forward, or to a rope or horizontal staff, the body inclined back; often squatting; occasionally sitting semi-recumbent in the lap or on the floor; semi-recumbent or kneeling erect; more rarely recumbent; standing erect, clinging to the neck of an assistant; tied to a tree, or suspended; and the knee-chest position.

Central and South America

Nicaragua.—Kneeling.
Guatemala.—Squatting.
Venezuela.—Semi-recumbent, seated in a hammock.
Peru (*Ancient and Modern*).—Semi-recumbent in the husband's lap.
Chili.—Semi-recumbent in the lap.
Brazil.—Recumbent on the ground or in a hammock.

Australia and Surrounding Islands

Australia.—Sitting erect; recumbent.
Ceram.—Standing erect; suspended.
Polynesia.—Squatting.
West Micronesia.—Squatting.
New Zealand.—Kneeling.

Sandwich Islands.—Semi-recumbent on the lap, or lying on a mat.

(The Burmese seem to be among the few people who adopt the dorsal decubitus; they have trouble with the perineum, and the native midwife keeps one finger-nail long to slit it when the head appears.)

Dr. Hope Trant writes to me in reply to my advocacy of the natural position in childbirth:

"I am greatly interested, as I am in charge of a native maternity hospital in Johannesburg, where we often get the women to squat if there appears to be no advance. I find it helps a lot in some cases, but we have then no control over the perineum, so that the baby is apt to shoot out and the perineum to get torn, but I am sure one could devise some couch on which this position could be adopted and still control of the delivery be maintained."

The Rev. A. Sturgis, Missionary to the Micronesian Islands, wrote to Engelmann:

"The natives of the Micronesian and surrounding islands, like the Modocs, are delivered upon their hands and knees, sometimes in a recumbent position; certain of their old women act as midwives. They roll about as they please until the very last stage—the expulsion of the child—when they take this position, upon the hands and knees, and retain it usually until the placenta is expelled.

They have no peculiar ceremonies, but apply to their ghost workers for intercession in their behalf in case of difficult labour or sickness.

Massage and expression are used, especially for the expulsion of the placenta and after labour to hasten the contractions of the womb, when the woman lies upon her back and her belly is kneaded. Difficult labour occurs seldom; and during thirty years' residence Mr. Sturgis has never known of a single case of death of the mother in labour."

Dr. Reamy, of Ohio, also wrote to Engelmann:

"I have found in my practice ten or twelve different women, who had frequently borne children before, who insisted with a perseverance and determination that I dared not resist, in being

out upon the floor, down upon their knees, leaning backward so that the buttocks almost touched the heels. The husband knelt behind the wife, with his arms around her . . . and making pressure during pains. . . . The same position is found among the Papagos." The position of the squaw, from the time the labour pains commence until the expulsion of the fœtus and placenta, is a kneeling one, with knees sufficiently spread to furnish comfortable lateral support to the body, which is erect. In the interval between the pains she is allowed to move about according to her inclination. In ordinary labour two women assist her. He adds, "They understand they must use time and patience with primiparæ. . . ."

Tristan Da Cunha

The Rev. A. G. Partridge, M.B.E., who was for four years on the Island of Tristan da Cunha, where the teeth have been described as almost perfect, tells me in answer to a question that:

"All confinements were very easy. No midwives but relations were called in to 'help.' None of the women have ever died in childbirth. None of the children born have died at birth. All are suckled by the mother for a long period, though 'potato gruel' is given by spoon a day or two after birth.

The umbilical cord is tied with string. They bite it.

A very interesting point is that the women bear children alternate years only. It is unknown on the island for a woman to conceive every year."

A report of an investigation in January, 1932, was made by Mr. Moore, a dental surgeon, and Surgeon-Commander E. A. Sampson, of H.M.S. *Carlisle*, in which they say that "out of 156 individuals examined, ranging from a few months to ninety-two years, a total of 131 are entirely free from caries, and their dental condition can only be described as perfect. Such a state in any other community is entirely outside our experience."

Further, they state, "the teeth are strong and well formed," and comment on the civilized slogan, "A clean tooth never decays," by saying: "This is entirely contradicted by the Islanders, as in no instance could we get an admission of tooth-

cleaning. The suggestion caused amusement, yet decay is practically absent."

Flour, sugar, jam and tea are practically absent from the dietary.

South Australia

Mrs. Daisy Bates, C.B.E., who sold everything and gave the money to help the aborigines, and who has spent nearly forty years among the cannibal tribes in Australia and who can talk 150 dialects, writes to me as follows:

"You are quite right in stating that difficulty in childbirth began with civilization. Of course, I can only speak of the Australian natives. They kneel down with knees wide apart, buttocks resting on feet, and the baby is born in a moment without pain. If an older sister or mother is not near they snip the umbilical cord with their finger and thumb-nail, leaving sufficient cord on the baby to tie it in a knot. When the knotted little cord length withers it is taken off and made into a sort of 'ring' with string and tied round the baby's neck, 'to keep evil magic away' and 'make baby grow.'

The baby is placed on its back on the soft sand, rarely cries, as white babies are said to do at birth, and may go some hours before the mother puts it at the breast. The placenta comes away also painlessly, and is placed in a hollow made in the sand and a fire made over it.

I have been at many births and all are similar, and without pain. The mother will drink (water or tea) and eat anything that her sisters, etc., may bring to her. (I usually give them bread and sweet tea, which they all like tremendously.) There is no pain before or after birth. . . . Women are 'unclean' to their men both during their periods and at childbirth. . . .

Their teeth, when young and middle-aged, are always perfect, and I think this is largely due to their long periods of suckling. I mean the babies—while the mother has a drop of breast milk, the child of three, four, five, will suck her . . . all day long and through the night. I've never seen a native baby with rickets; it cuts its teeth on bones. The babies become intelligent earlier than white babies—that is, when there are other little children in camp—and they, the babies of a few months,

PLATE VII

FIG. 39.—YORUBA WOMAN, SQUATTING POSITION.

FIG. 40.—YORUBA WOMAN, POSITION FOR CHILDBIRTH.

To face page 115.

will be given reptile liver or some such soft and lightly cooked meat. . . .

The mother carries them astride on her hip, her shoulders, her head, across her back, holding them by arms and feet round her waist, so to speak, or if they are very tiny she will put them in a wooden scoop and balance them on her head. The wee babies are lovely to me, so soft and fat and perfect in shape. . . . I have always thought the squatting-kneeling position the very best for childbirth, but probably corsets, etc., may alter things. And a woman will get on her feet an hour or so after her baby is born and may walk twenty or more miles, if her mob is journeying to fresh waters, or is on its way to civilization. I have known a woman to walk forty miles and feel only tired at the end."

Then follows a description of the Central natives, who in their wild state incise the posterior wall of the vagina at puberty. Mrs. Bates wondered if this helped to make childbirth easy, but says she has seen babies born where such a custom was not observed and the births were just as easy—the attitude being as described. She also describes cases where the mothers eat their own infants. For this she punishes them, and they are ceasing to do so. It must be remembered that they are hereditary cannibals, and Mrs. Bates, with her devoted and self-denying labours, is the first teacher they have had.

Northern Nigeria

Dr. J. R. C. Stephens, of the West African Medical Staff, writes from Ilorin, Northern Nigeria, as follows, and encloses two snapshots which were taken of his interpreter and daughter posed to show the normal delivery position as it was impossible to take photographs of an actual birth. The study of the girl alone illustrates the position for defæcation (Fig. 39), and he notes that women *stand* to urinate while the men *squat* to pass water.

"The medical officers here do not see much midwifery because the labour is generally painless and short, and often a woman brings to my out-patients a child born a few hours before, she carrying it on her back and walking sometimes a long distance."

He describes occipito-posterior positions as occasionally occur-

ring and often being fatal, as the relatives are frightened to take the patient to a European.

"The baby is born with the mother in a sitting position, the woman resting her arms, generally, on the knees of a friend of her husband or one of the family who sits behind her (Fig. 40) . . . sometimes on the floor. . . . Generally a brother or member of the family sits minus all clothes but a loin cloth in the position of my interpreter, and the woman sits on the ground with her knees flexed. I have had two confinements in the last week, both B.B.A.'s, and when I arrived the woman, an educated clerk's wife, was sitting on the floor (with a woman sitting on a comfortable bed) in this position. They never cut the cord until the placenta is born, and often the poor child lies on the ground . . . only an *old* woman is allowed to wash the child at first.

As to teeth, most Yoruba women file their teeth as girls. The blacksmith in the market-place does it, with a chisel and hammer to get off the corner and then files the two central incisors into an inverted **V**-shape." (Two teeth enclosed.) "Very many women have lovely, regular teeth, quite different from what is seen in England."

Dr. G. D. Reed, in his recent book, "Natural Childbirth," quotes Dewees as saying: "Pain in childbirth is a morbid symptom," and refers to Professor Huxley as having stated that the bearing of children may, and ought to, become as free from danger to the civilized woman as it is to the savage. He then goes on to say how women of native tribes look on childbirth.

"To have conceived is her joy, the ultimate result of her conception her highest ambition. . . ." He goes on to describe a confinement he witnessed himself.

"A sub-tropical sun was beating down; the temperature was nearing 110. I was told that a girl had been taken ill, and I walked over from our camp to a field, in a corner of which, in high undergrowth, I found her by herself. She did not in any way appear to resent my intrusion, as I was known by the natives as 'the doctor.' With the recurrence of the contractions, which appeared to me to be out of all proportion in their violence to those of the average European woman, her face became set, not with pain or fear, but almost with a sense of stern expectancy. I sat down and smoked a pipe and waited, knowing enough of their customs

to realize that no interference would be welcome. Within a short time a child arrived. It is possible that during that last ten minutes there was evidence that her expectation amounted almost to apprehension. The child appeared when she was in a half-sitting position. It seemed that she smiled almost immediately. I felt then that my presence was unnoticed. For some minutes it lay and cried, and she took it in her hands. After a time its yells were all that could be demanded of a newly born baby, and I observed that the cord was already like a thin white string. She took this in her fingers, about six inches from the umbilicus, and neatly severed it—whether by tearing or with her long nail I could not see. She wrapped her baby in the cloth that was round her own shoulders and then looked at me and laughed. It may possibly have been five minutes later when contractions recurred, and with the minimum of effort the afterbirth arrived, and certainly with the minimum of hæmorrhage, for, so far as I could see, there was none." Upon later enquiry he was told that the woman had arrived back safely at her village carrying her baby, and the incident passed as normal among her people.

He noted specially the spirit of joy, of happiness and pride, at the arrival and sound of the child; and how separation and expulsion of the placenta all took place while the mother evinced her joy.

In the same manner I have seen a mother in France rejoice who had been propped up to hasten delivery and so actually *saw* the birth of her infant.

I became suddenly aware of how much pleasure we deprive a mother by not allowing her to see her baby *at once*. There is a material consideration also involved: the sight of the new-born child causes uterine contractions and so hastens the expulsion of the placenta.

The following case first made me interested in Indian obstetric practice, for when I was called to a difficult and delayed confinement in an Afghan family of high caste, I had decided that the woman I was called to only needed rest, but custom demands that the woman in labour must on no account be allowed to sleep, and to this end drums are often beaten at the bedside, and the Koran read in a loud voice to keep her awake.

I told them to give her a bowl of hot bread and milk, and sat

by her afterwards while she slept, to make sure she was not awakened.

When she woke up she asked if she might be confined "as their custom was." A woman, possibly her mother, knelt behind her and supported her under the armpits, while she knelt on the floor with knees apart, and the child was easily born into my hands as I knelt in front of her. In a few more minutes she pressed her abdomen and the afterbirth came away. Then she got on to her bed, a mattress spread on the floor. Is not this the natural posture we read of in Gen. xxx. 3, when Bilhah's child was delivered on Rachel's knees?

Mothers have thus delivered their daughters, and friends their friends from the beginning of time.

I have just come across an interesting example of natural and instinctive posture assumed during birth in France. The young wife of a doctor, not far from Bordeaux, was expecting her first child, but she resisted all attempts to get her to go to bed when her pains began. She insisted upon doing as nature urged her, and was confined on hands and knees on the floor quite safely about seven hours after her pains began. As the head appeared, she was persuaded to get into bed. She was not torn. On discussing the matter with another French colleague, he tells me that he is sure that when he is not there, and the case is left to the "sage-femme," she lets the patient adopt any posture she likes.

An experienced *infirmière* in Bordeaux, whose home is in the Pyrenees, tells me that thirty years ago she constantly saw women delivered in the crouching position with perfect safety, without either doctor or midwife. It was the custom. Both her mother and her aunt delivered themselves thus in her presence. Again, a French lady tells me how she met a beggar woman in labour by the roadside. The woman was in the squatting position, and when the child was born she walked away with it quite unconcerned. In France, childbirth is much easier among the country people than among English or Americans.

Because we hear of "childbed" we are accustomed to think women always went to bed to have a baby. Not at all. They went to bed, as they still do among Easterns and nomads, *after* the birth of the child and placenta. One example of this was

given me by Dr. Annette Benson, of the Cama Hospital, Bombay. Her old family nurse in England, a village woman and the mother of several children, described to the doctor how she got everything ready for herself at such times—water, soap, and so on—and then as the birth became imminent she went to her bedroom, locked the door, knelt on the ground with her elbows on the bed and thus gave birth to her child. When she had washed herself and the baby she unlocked the door.

Childbirth in 'Iraq

(From Mrs. Drower, Baghdad)

Women of better class are now accustomed to the hospital—*i.e.*, European—method of delivery on a bed. But this is unnatural even to them, and the time-honoured method is that of squatting on the heels and grasping something in front, often a rope. But there are marked differences of method.

The fellaha, if in a house or out of doors, squats on her heels, and holds on to another woman, while a third (the jidda or midwife, or any old woman) takes the child from behind.

The Ma'adan, those who live in reed-huts, squat holding on to the great reed ribs of the hut, and present the buttocks to the jidda, who takes the child from behind. To ease her pain, the woman presses her forehead against the reed support.

The usual method of the poor in the towns is to squat on the heels, as said above.

Jewish women of 'Iraq squat in front of a stool, which they grasp with both hands, their feet being on a brick placed on the floor. The jidda delivers from behind.

Kurds precisely the same as the fellahat and other Moslem women of 'Iraq.

Turks sit in a chair during the pains. Whether the chair has a hollowed or cut-out centre I do not know. They do not properly belong to this country.

Hedjazis use a chair also, but not cut-out or hollowed. When the child is nearly born they rise and stoop forward.

For this information I am indebted to 'Iraqi women, but have not witnessed a birth myself.

From the Bureau of American Ethnology, *Labor*, p. 55, "Delivery takes place while the woman is squatting or on her knees or on hands and knees or elbows, or lying down; frequently she holds on to an attendant or to a sash, rope, strap or stick. Kneading of the abdomen and steaming are practised." In the same volume we are told that among the Fox Indians giggling is discouraged, for "the girl who giggles is apt to succumb to sexual advances."

Midwifery Among the Alaskan Indians

(By J. K. Simpson, M.D., Juneau, Alaska)

The following notes on midwifery among the south-eastern Alaskan Indians, the result of four years' experience amongst them, may be of interest: I will not discuss their superstitions, beliefs, and theories concerning midwifery, but will describe as briefly as possible their manner of conducting a case of labour.

When a woman arrives at full term a tent or hut is erected at some distance from the Indian village. A hole about two feet deep is dug in the ground inside the hut (or tent), and is lined with moss. A stake is driven into the ground a few inches from the hole. When labour begins the woman is made to sit over the hole in a squatting position as though she were in the act of defæcation and using the hole as a privy vault. She grasps the stake with both hands. One squaw sits behind with arms clasped around the patient's abdomen, and another sits at each knee to act as a brace or support. They make no examinations, the midwife not being allowed to see the vulva of the patient under any circumstances. When a pain comes the patient holds on to the stake, the midwife clasps her arms more firmly about the abdomen, and the other two women press firmly against the knees of the patient with their shoulders. This is repeated with every pain until labour is concluded. When the child is born it drops into the hole, where it is left for five or ten minutes, or sometimes longer. Sometimes the child is seriously injured by the fall, and bones are occasionally broken. In case of fracture, no treatment is followed, the bone being allowed to unite as it

will. The umbilical cord is divided about four inches from the navel. They do not cut it, but, taking hold with their fingers, twist it, and partly pinch it off with their nails. They do not tie it, as the torsion prevents hæmorrhage.

The third stage is managed in the same way as the second, the women supporting the patient and assisting her as before. The placenta is generally burned or cremated and the ashes preserved until the child dies. The Indians here cremate their dead, the ashes being afterwards put into a receptacle, which, with some of the property of the deceased, is placed in a small burial-house. With those ashes the ashes of the placenta are placed; sometimes, however, the placenta is buried.

After the placenta is removed the binder is applied. This consists of a number of pieces of bark about a foot long and two or three inches wide, placed parallel to each other and quilted between two pieces of cloth or skin, like the bones of a pair of corsets. This, when applied, resembles a very coarse set of stays. The binder is left on ten days, during which time the woman is never washed. The blood and discharge become encrusted about the vulva and thighs, and, as it is moistened daily by the urine and lochia, her condition may be better imagined than described. Strange to say, I have never seen nor heard of a case of puerperal fever among them, although there have been about 200 births in this neighbourhood since I came here. During labour, and for ten days after, the woman is not allowed to eat or drink anything cold. Primiparæ remain in bed in the hut in which they were confined for ten days, but many multiparæ get up and go about their work the first or second day.

To return to the child. It is first "fished" out of the hole and the cord divided. The midwife has a box or bladder containing a foul-smelling mass consisting of the leaves of some herb which has been chewed months before. A portion of this is applied to the stump and bound on. The child's face is then wiped, but no part of the body is washed. It is wrapped up and placed in a laced, bag-like arrangement (stiffened with bark in the same manner as the binder), which covers all of the child but the head. It is taken out of this to be cleaned three or four times daily. The child can be carried around like a sack of grain, but

it is generally bound on the back of the mother. When the cord becomes detached it is covered by a piece of buckskin, which is nicely beaded. This is stitched to the breast of the child's clothing (like a rosette), and is worn by him until he is three or four years of age, when he is sent into the woods to hide it. There is a superstition connected with this which would take too long to detail.

In conclusion, I must say that their ignorance of midwifery is astonishing. In simple, uncomplicated cases they have, of course, no trouble, but if there is the slightest complication they are helpless.

In Hunza

Mrs. Lorimer, wife of the British Resident in Gilgit, travelling among the Hunzas, tells me that just as you could not rush into an English lady's bedroom to see her confinement, so at such a moment you cannot interview a Hunza woman, in spite of the fact that several days had been spent at a maternity hospital in London with this object in view, so the following is obtained by hearsay:

The confinement takes place in the open space by the hearth, on clean earth spread for the purpose. The patient squats or crouches, and the husband is posted at the door and a brother on the roof beside the smoke hole to keep off intruders (actual or supernatural). When the baby is born the attendant women bathe and wrap it up while the mother lies down on a pile of clothes, etc. Three days later she bathes herself and dresses in clean things. Seven days after she bathes again, dresses in her best, receives callers and congratulations. And a fortnight or so after she resumes light field work. The Hunzakuts are extraordinarily considerate of their women. Special rations are allotted to them during the whole time of pregnancy and lactation. They suckle their infants for two to three years (no other baby food is available, for cows are few, give little milk and only for a short period after calving). During *all* the time of pregnancy and lactation the husband retires to the men's sleeping bench, and would be eternally outcast if he spoke of marital rights as overriding the rights of mother and child. Thus their infants are

spaced at about four-year intervals; to everyone's advantage. We could, of course, get no statistics, but as far as our fourteen months' observation went infant and maternal mortality were very low—weak stocks having long ago perished. The women look extremely happy and care-free even to late old age, in spite of very hard work and great poverty.

The author then describes a white-haired old woman playing with a boy of five. When it was suggested he was her grandson, she said, "Not a bit of it, he is my *great* grandson, his father was my favourite grandson, and when the child's mother died in childbirth *I suckled the boy myself.*" One other odd detail is recorded: in one of their old folk tales, the heroine (a disguised princess) is asked, "Will you bear your infant in the ordinary way or in the royal manner?" And the explanation was given that in olden days the royal mother crouched above the smoke-hole and attendants inside the house caught the baby from below.

From "The Home of an Eastern Clan, the Palaungs of the Shan States," by Mrs. Leslie Milne:

"Those who are rich sometimes possess chairs imported from Rangoon or Mandalay, but they rarely use them themselves, as they say that to sit on a chair makes them ache all over" (pp. 8 and 278).

"Palaung women do not arrange to have an old, wise woman with them either before or during the time that a child is being born. There are no professional midwives in the country, child-birth being looked upon as a perfectly natural event and not as an illness. When the time comes women friends make her walk backwards and forwards quickly, and she goes out and pounds rice, returning when pain begins. Others hold the lintel of the door, swinging themselves backwards and forwards off their feet. They stand or sit when pain is severe, but in no case do they ever lie down. It takes two to eight hours, seldom more, from the beginning of pain until the child is born.

The woman just before the birth kneels down with elbows on the mat. After the child is born she lies on her back and they massage her from her chest down till the afterbirth comes away, and the navel cord is not cut till then.

If the placenta is delayed they cut the cord, tying both ends and cutting between the knots and *tie a stone* to the maternal end. The cord is cut with a sharp bamboo, and the father buries the afterbirth. All Palaungs sit in a squatting position."

The photographs in this book show perfect teeth and jaws.

If the left lateral position, as employed in England, has any advantage it is in avoiding tears of the perineum, but it is obvious that the crouching position, which takes the weight off the pelvic floor, is better still, and it also gives freedom to the pelvic joints.

All positions, such as squatting, kneeling, on all fours, hanging from a tree, bending back with head on floor (Italian), on stomach (Crow-Creeks), sitting on husband's lap (Canada, Virginia, Ohio and Georgia and Andaman Islands, etc.), and the "position Anglaise," which causes so much astonishment on the Continent, all are possible, but certainly all are not of equal expediency.

Engelmann states his carefully considered conclusion that, as among all people, both ancient and modern, the recumbent position in childbirth is very rare, he therefore feels sure that the obstetric position of to-day is an unnatural one.

He says he has enquired into records and sculptures of the past and "deprecates that we in this age of culture should follow custom or fashion to the exclusion of reason and instinct," and, p. 56, he thinks "the semi-recumbent and inclined positions are the correct ones anatomically, theoretically and practically, and we have unquestionable ethnological proof of this assertion."

As long ago as 1779 Hopkins objected to the lateral position and advocated the position on hands and knees, and Denman stated, "this posture is instinctively sought by unassisted women," and White in 1791 advocated it, as it prevented too great a pressure on the perineum.

In 1870 H. von Ludwig, of Breslau, advocated that the kneeling or squatting positions should be assumed during the expulsion of the child on theoretical grounds, and pointed out in justification of his contention that women of savage races living under natural conditions instinctively assume these positions.

Ramsbotham stated that the peasantry of both Ireland and

Cornwall were confined on hands and knees (and that in Cornwall *standing* was also practised).

Engelmann tells us how, left to themselves, immigrant women in America will follow traditional peasant customs of the countries of their birth, so that Welsh women were reported as confined on hands and knees or even on the laps of their husbands.

He also points out for our benefit that obstetricians may flatter themselves that they have discovered the knee-elbow position and its use during version, but the untutored Redskin now does and has probably always done exactly the same thing, and he instances the squaws of the Araphoe tribe.

The Placenta, Cord, and Sepsis

After the delivery of the child among native races the umbilical cord is usually severed, but not always, as in some cases it is customary to wait for the placenta to be born before detaching the child.

In some tribes the fall of the child is said to be sufficient to rupture the cord.

In certain Australian aboriginal tribes the severance is accomplished by the mother's teeth—she bites it off (as animals do). This does what is needed to release the child and stop hæmorrhage.

Other races cut the cord with a piece of bamboo or shell. In India a piece of tin, or a knife (used for cutting up meat or cleaning the vegetables), in fact any sharp implement may be employed, or it may be merely the midwife's finger-nail that accomplishes the final separation of the new-born from the mother.

The fœtal end is then dealt with in various ways; it may be twisted up into a knot, seared with a hot iron, compressed between finger and thumb, but always some care would seem to be taken so that the infant should not lose blood. But as far as I can ascertain among races living in natural conditions no notice is ever taken of the maternal end of the cord. It can bleed as it likes—the more the better, and the mother is made to move about with this in view; if it is tied it is only to attach it to the woman's thigh (in China) or foot (New Caledonia) by a string, to aid the expulsion of the whole placenta. They seem to know that the

blood in it has no communication with that in the mother's circulation. Smellie pointed out in the early part of the nineteenth century that the cord when severed *should not be tied on the maternal side*. It would seem that massage and expression is used by nearly all people if the separation of the placenta is delayed.

In 1925 (*British Medical Journal*) I wrote as follows on the separation of the placenta:

"For some time it has seemed to me that to ligature the maternal end of the umbilical cord after the birth of the child is a useless and in many cases a harmful procedure.

My attention was first called to this point when performing Cæsarean section, when the object was (after the extraction of the child) to get the uterus as fully contracted as possible before introducing sutures. I noticed then that by leaving the maternal end of the cord untied, so that it could bleed freely, the placenta was more easily removed and the cut uterus contracted more rapidly and firmly and consequently needed fewer stitches.

Then again, after delivery in septic cases, such as often occur in Kashmir, where hollyhock root, cow dung, fowl intestine and quince seeds are found in the vaginæ of women treated by the native midwife, and where the cord when cut sometimes exudes a yellowish juice suggestive of fæcal matter, it seemed a distinct advantage to get rid of as much of this as possible, and I considered that the placenta came away more quickly when the maternal end of the cord was not tied, but left to drain.

While the child is living and attached to the mother the blood-pressure in the cord is positive. When the cord is cut and the maternal end is allowed to bleed the pressure in the cord is negative, the blood is drained out of the placental vessels, and the villi shrink in the maternal sinuses and collapse, thus favouring their detachment from the uterine wall.

Each contraction of the uterus causes blood to exude from the cut end of the cord and the placenta is diminished in volume, and each relaxation of the uterus will only loosen the villi dipping into the sinuses. Each pain causes contraction of the uterus and placental site.

On the contrary, the usual procedure of ligating the maternal end of the cord causes the pressure in the cord to remain positive, and when the uterus contracts the villi are full and the uterus

cannot contract fully. When the uterus relaxes there must be a suction action exerted on the placenta, and its expulsion is delayed. I am inclined to think that tying the maternal end of the cord is inadvisable because—

(1) It delays delivery of the placenta.

(2) It prevents full contraction of the uterus, thus leading to increased hæmorrhage.

(3) It increases liability to retention of placenta or portions of it.

(4) It involves a risk of septic infection through maternal sinuses which are still kept open by the engorged villi.

Perhaps one of the chief factors in the normal separation of the placenta from the uterine wall is the tendency of the empty villi to detach themselves; this may explain why the common and reprehensible custom of the native midwives of pulling on the cord to remove the afterbirth is not so deadly as it sounds. They do not, as a rule, tie the upper end of the cord; if they did it would be easy to understand that pulling on it with the villi full of blood and intimately connected with the maternal sinuses might invert the uterus.''

Several letters followed, notably one from Bethel Solomons, who expressed the opinion that to leave the maternal end of the cord untied caused better separation of cord and membranes; another, from W. G. Evans, who considered it lessened the bulk of the placenta and helped its expulsion, lessened hæmorrhage, and made manual expression (if necessary) more successful. After fifty years' experience of single ligature he is certain of the advantages. Another letter stated that Berry Hart held the same views. Then why do we still tie both ends?

Because not to tie the upper end is to risk soiling the bed linen —and I believe the practice originated with the midwives (when it became the custom to have clean bed linen), and the practice has been accepted without much thought.

In France, after the birth a clamp is put on the fœtal end of the cord and removed after twenty-four hours, while artery forceps are used on the mother's side, but this is not really needed to avoid soiling the bed, as the confinement takes place on a flat, open bed-pan, which receives all discharge.

Cariglia (*Nouv. Arch. d'Obstet. et de Gyn.*, vol. vii., No. 9) recently showed by experiment that the afflux of blood which the

fœtus receives from the placenta directly after birth is caused by the contraction and retraction of the uterus.

This afflux would probably be more if the mother were kneeling or crouching, so that this position might be of direct service to the infant, thus supplying it with more blood.

The Pelvic Floor

In every civilized confinement special care has to be taken of the perineum.

And yet after the crudest midwifery in the East one often finds an intact perineum. What is the reason of this comparative immunity from tearing?

It is without doubt a question of posture. The civilized perineum is never stretched, so that the whole structure becomes atrophied and the muscle fibres shortened.

Sir Arthur Keith tells us ("Man's Posture, its Evolution and Disorders," *B.M.J.*, vol. i., p. 24, 1923) that—

"Modern anatomists no longer regard the postural adaptations of the human body as the result of a transformation peculiar to man as did Lamarck and Darwin . . . they regard man's gait and posture as the culmination of a series of evolutionary phases. . . ." He shows how the tail muscles become the pelvic floor and how the symphysis is tilted upwards towards the umbilicus. Also that all animals raise the tail in defæcation and in parturition.

He says: "The body weight tends to tilt up the hinder or coccygeal end of the sacrum and would do so were it not (1) for the form and strength of the sacro-iliac joints, (2) because the hinder end of the sacrum is bound to the ischial tuberosities . . . by the sacro-sciatic ligaments. . . . It is not true, however, to say that our spines are not perfectly adapted to the upright posture, it would be more accurate to say that human spines were not evolved to withstand the monotonous and trying postures entailed by modern education and by many modern industries."

Now these tail muscles are still used and exercised daily in uncivilized man who squats for defæcation.

The squatting position opens urethra, vagina, and rectum. In the European, and still more in the American, the pelvic floor is a

degenerate structure; the muscles composing it are atrophied and rigid. For with the oval pelvic brim goes the oval outlet, the elongation in this case being from back to front and the shortening from side to side.

As the head passes through it, the muscles forming the pelvic floor, and attached to the walls of the pelvis and the sciatic ligaments, are unequally stretched and give way in the mid-line as the ischial tuberosities are forced apart by the passage of the child's head.

By contrast, in the crouching or all fours position, with the mother's body bent forward, *all pressure is taken off the perineum*, for as the woman kneels the weight of the fœtal head falls forward and rests on the pubic symphysis as it rotates under the pubic arch to be born.

Thoms, in his recent book, "The Obstetric Pelvis," shows how a narrow pubic arch is a direct cause of tears of the perineum, as the occiput is prevented from coming well forward under it.

Dr. Rosetta S. Hall, in the *China Medical Journal*, September, 1927, says:

"For a few years past my attention has been called to the comparatively few torn perineums among the Korean women who visit our gynæcological department in Seoul and Chemulpo, and prior to this I had noticed the same in Pyong Yang. And I am trying to ascertain why there are better results among women unattended by doctors or midwives in Korea than in hospital work in U.S.A.

I have now only the records of some 3,000 cases to which I can refer, and sometimes I have neglected to make notes, but I find in the cases noted that about 75 per cent. were *delivered upon their knees*, Korean custom, and only 20 per cent. delivered this way were torn a little, and they usually gave history of a too rapid labour; 55 per cent. had *no* tears!

Of the whole number 25 per cent. were delivered with the mother lying upon her back, and they were *almost always torn*, some quite badly; only 3 per cent. of the whole number delivered that way had no tear!

With a few exceptions, these delivered upon the back had either a midwife or a physician; of course, they *may have been* the more difficult or abnormal cases.

It is stated that 20 to 30 per cent. of primiparæ receive a perineal tear in hospital practice in U.S.A.

Since this injury to the perineum is rather less when primiparæ are delivered by the Korean method in their homes, I am forced to the opinion that the position of the mother has much to do with it."

There is another point worthy of notice regarding the effect on the pregnant woman of these positions. Squatting not only prevents her being constipated and so lessens the risk of toxæmia during pregnancy, but it keeps the fœtal head malleable and compressible and prepares it for birth, for when the pelvic joints are relaxed, as they naturally are during the last month, and the mother squats, the perineum is stretched, and the child's head is daily pressed into the pelvis like a ball into its cup.

On the other hand, when the head only enters the pelvis just before labour begins, it has had no chance to "try the fit" and accommodate itself, and the labour is not likely to be such an easy one.

Sepsis

Just as important as the natural posture during birth is the correct posture to be maintained by the patient during the lying-in period.

Sepsis has for many years been the cause of the greatest number of fatalities in childbirth, and the largest number of these followed what is called "normal labour"—the woman lying on her back or side.

Confine a woman sitting on a low stool, or kneeling or squatting on the ground, and you cannot infect her, because all discharges pass downwards. Nurse her afterwards in the best position for drainage—in bed with her back well propped up by pillows, and with knees drawn up to the chest. This will ensure such free discharge that it makes it impossible for germs to make headway against the downward current. All native races know this; the woman walks about or squats just as she feels inclined. Separation of the pelvic bones entailed by this slanting position tightens the ligaments of the uterus, squeezes the uterine muscle and expels the lochia, and all avenues of infection are sealed.

On the contrary, it is easily seen that if a woman lies on her back, as is now customary, discharge accumulates and forms a stagnant pool in the lax vagina, and there is every chance for infection to occur. Without exercise the uterus remains flabby and is more liable to infection than if it is well contracted and the sinuses closed.

All animals left to themselves after parturition have a short period of seclusion. It is a question whether our civilized practice of allowing visitors during the lying-in period is not more harmful by causing nervous strain than *quiet* sitting and moving about.

CHAPTER VII

CONCLUSIONS

In 1932 I was allowed by Dr. Voulland, of the Government Maternity Hospital, Benouville, near Caen, to live for six weeks in the hospital of which he was director.

I wished to study the effect of exercise on the abdominal muscles and pelvic joints of the expectant mother and to observe the result of propping the patient up in bed instead of letting her lie flat during her confinement. This idea that the head must not even be raised on a pillow is a cardinal point in French obstetrics, so, to begin with, we took a few blood-pressures and found that they were higher when the woman was sitting up than when she was lying down, so there seemed little risk of syncope if we made her sit up to be confined.

I was able to hold a class of exercises for the women waiting for their confinements, who meantime were engaged in the laundry, kitchen and general housework of the place.

Young girls wishing to become professional midwives received a two years' training after passing their matriculation. They attended lectures at the Caen University in addition to their hospital work at Benouville, where they did the nursing under the supervision of highly qualified midwives of long experience from the Paris schools. They wore a practical uniform of white cotton open at the neck, with short skirts and no sleeves, and were trained both in midwifery and monthly nursing; they were taught the use of forceps and how to deal with and deliver cases of abnormal presentation, and were expected to know the reasons for all that was done. They received instruction in the giving of the anæsthetic when needed (ether was always used), and learnt how to prepare and sterilize all instruments and dressings required. The post of municipal midwife is a coveted one in France. A motor ambulance was available to go at a moment's notice to any part of Calvados to fetch patients.

I began with a class of four or five pregnant women ten days or less before their delivery. They were at first unwilling, but

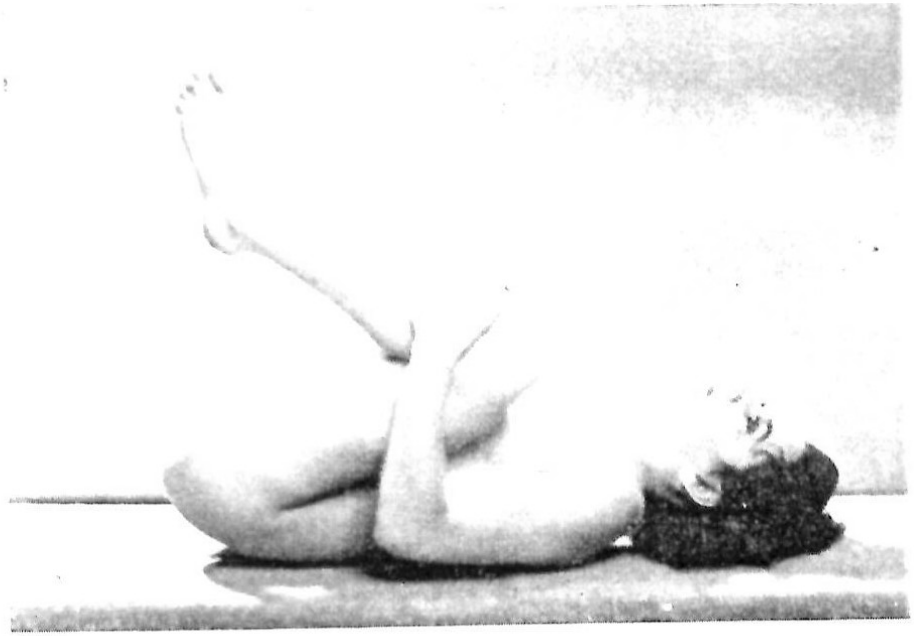

FIG. 41.—HOLDING BOTH LEGS.

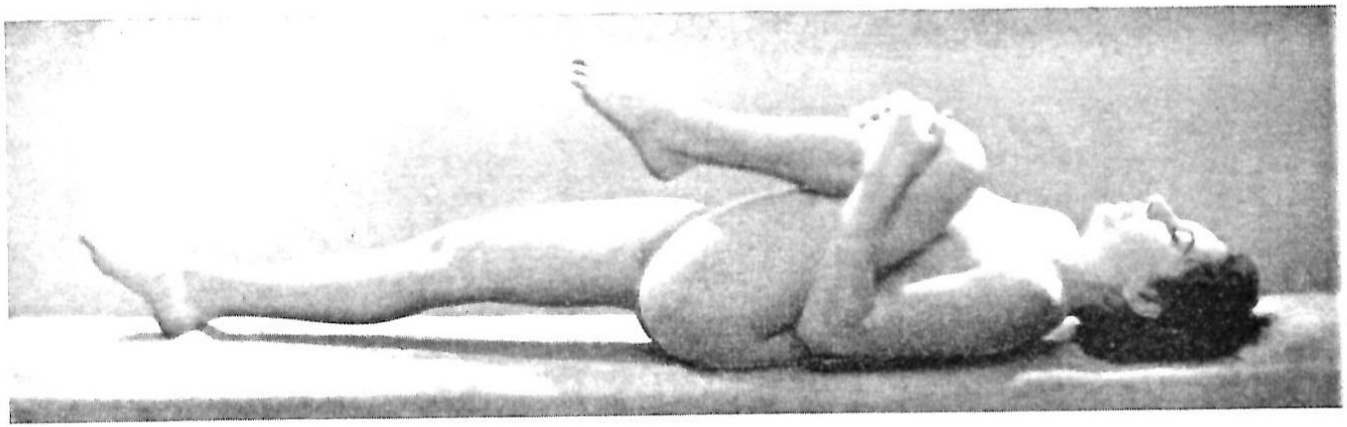

FIG. 42.—RELAXING THE PERINEUM.
Posture for childbirth used in France.

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afterwards they enjoyed the exercises, and I had fifteen women in the class at the end of the time.

These exercises were designed to loosen the pelvic joints, to stretch the sacro-sciatic ligaments and the muscles of the pelvic floor, to give tone to the abdominal muscles, and to encourage the fœtal head to descend into the pelvis.

They were as follows:

1. Deep breathing with open windows.
2. Leg swinging, holding on to the bed, and kicking up forward and back. (One young woman kicked her hand easily a few days before delivery.)
3. Leg swinging in circles.
4. Standing before a chair, each leg raised in turn and the foot placed on the seat.
5. Bending forward, holding low foot-rail of bed, feet together.
6. Squatting, holding on to rail of bed, knees well apart.
7. Squatting, knees together.
8. Ascent of eighty stone stairs two steps at a time (not holding the banisters) and descending in the same way.

This drill was gone through twice a day. It certainly improved the patients' general condition and shortened labour.

In France, confinement takes place on the back in the lithotomy position, as advocated by Paré in the sixteenth century. The patient's head is kept low, no pillow even being allowed, and the buttocks rest on a heart-shaped bed-pan, which receives all discharge. The woman abducts the thighs and holds her own legs in position (Figs. 41 and 42). She is told to bear down until the head appears at the vulva, when she is instructed to cry out to relieve the strain on the perineum. One patient, a primigravida, was more comfortable on all fours on the bed, and seemed to take up this position naturally.

Progress was much more rapid when the patient was propped up on a bed-rest at an angle of about 40 degrees, but this rapidity increased the risk of a perineal tear. It was possible to avoid this tearing by making her release one leg which was then extended on the bed while she still held the other in the flexed position. This lessened the strain on the perineum.

The slanting position certainly hastened the labour—and in one case of contracted pelvis rendered forceps unnecessary, for the

second stage terminated naturally in two hours with the patient in this position, although everything was ready to deliver her instrumentally. The baby weighed $7\frac{1}{2}$ lb. The mother had bow legs and bad teeth.

A vegetarian diet is the most natural one for the pregnant woman. Fresh vegetables, fruit, nuts, grain, milk also, but not food out of packets and tins. The size of the child is undoubtedly influenced by the diet of the mother before its birth and perhaps even more so *by her activity*, and we have to teach that mere bigness of an infant does not guarantee that it will be big at seven years old, and still less does it mean a big adult. A reasonably small child at birth often does better, because after an easy labour his mother may make a quick recovery and is in the best state possible to feed him. As regards exercise, during the whole of pregnancy it is essential to keep and make the pelvic joints supple, to exercise the sacro-sciatic ligaments, and to stretch the muscles and skin of the pelvic floor in preparation for the act of birth.

Good muscular development before parturition results in a speedy restoration of the figure, and the lochia cease earlier when the uterine muscle is in good condition.

But the time for exercise is *before* the confinement, not after. The lying-in period should be a time of rest after strain, and exercise then, if began too early, is liable to diminish the flow of milk.

Whether customary or no, the squatting position should be used during defæcation. This often prevents the constipation and toxæmia so common in pregnancy.

All the usual activities are good provided they do not involve strain and discomfort. Riding, as in New Zealand, does no harm where mothers are in the habit of riding, and often ride miles to the nearest hospital for their confinement to return home later with the baby on the saddle in front of them.

Exercises before or after childbirth, which contract the muscles of the pelvic floor, are to be deprecated. The civilized perineum needs *stretching*, which can only be done by practice of the squatting position with thighs apart. This widens the pubic arch at the same time.

PLATE IX

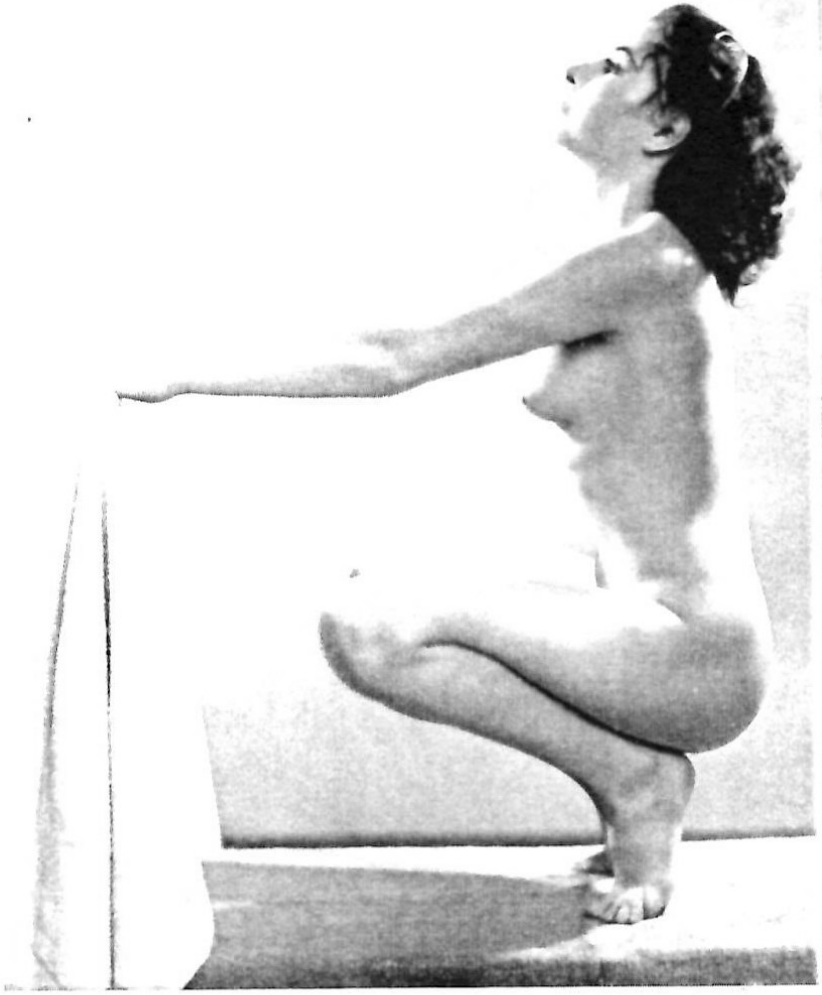

FIG. 43.—THE WATERS BREAK.

FIG. 44.—BEARING DOWN.

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METHOD

I shall be expected to outline a method to be followed when we wish to make use of the natural posture.

On first seeing the patient note teeth and gait, and so get a rough idea of the pelvic shape and state of the joints.

It is desirable that a simple X-ray apparatus, to view the pelvic brim (on the lines of the machine common in bootshops to view the bones of the foot), should be available, but such an instrument has not yet been designed.

At present the pelvic brim cannot be viewed in every case as a matter of routine, and yet the importance of this is obvious when we know that the shape of the brim is of more moment than its actual size. America sets us a good example in this respect. Thoms, in his recent book on the pelvis, stresses the valuable information only to be obtained by good roentgenograms.

There must, of course, be practice of the postures required in childbirth, with the reason for each change of position, before labour commences.

Why does the civilized woman allow herself to go into labour in complete ignorance of the methods of delivery with which she must co-operate?

The following is a rough sketch of the procedure I suggest, to be modified as occasion demands.

It is understood that all the ordinary measures to secure asepsis must be observed, and, as in France, the application of iodine to vulva, finger-nails, toe-nails, and gums is advocated.

First Stage (Fig. 43).—During the first stage the woman is restless, movement is encouraged, she walks about, and squats, and as the pains increase full dilatation is hastened by letting her squat or sit on an ordinary commode pan placed so that while the soles of her feet are on the ground she can hold on to something firm, such as the bedpost.

If the membranes break in this position the pan receives the discharge. Squatting brings the head into the pelvis and shortens the first stage, but is too tiring if the labour lasts more than twenty minutes.

Second Stage (Fig. 44).—A sterilized rubber sheet with rolled edge is spread on the ground or on a hard bed or table. (An

ordinary camp bath would do in an emergency.) On this the patient kneels, buttocks touching the heels. Keeping knees and thighs flexed, she leans back and presses the ground *behind her* with her hands to strain and so increase the pains, while to retard them she places her hands on the ground *in front* of her. She is then kneeling on all fours (Fig. 45).

As the head begins to distend the perineum the patient should go forward into this knee-elbow position (Figs. 46 and 47) to procure slow expulsion and easy dilatation of the parts, because this posture takes the weight of the fœtal head off the pelvic floor, and transfers it to the pubic bones, so facilitating the passage of the occiput forward under the pubic arch.

The midwife can take the infant from behind or, better still, can instruct the patient to sit back on her heels when the head emerges so that it passes forwards and upwards between the thighs. Or the woman may adopt the sitting position, clasping the knees, as in Fig. 48.

Third Stage (Fig. 49).—The umbilical cord is severed when it ceases to pulsate, but should be ligatured on the fœtal side only, the maternal end being left to bleed, so that it drains the placenta of blood and thus diminishes its bulk and encourages uterine contraction. The usual cleansing of the vulva should then take place, but the woman should not lie down until this is complete, lest any fluid enter the vagina.

If the obstetric chair be used, which is more convenient for the attendant, but not so good for the patient, it must be *low*, have a pierced seat, and be so constructed that it is both portable and sterilizable. It should be placed on a floor surface which is easily washed down.

The patient holds on to the arms of the chair while the feet are firmly planted on the ground, the knees being well flexed (squatting position).

For squatting and kneeling open the pelvis and turn the birth canal into a cylinder of uniform calibre, by stretching all joints, all ligaments, the muscles of the pelvic floor and the perineum.

The sacrum is in the mid-position and can swing back and forwards as the head passes.

All discharge flows away at once. The perineum is retracted with the levator ani and other muscles forming the pelvic floor.

PLATE X

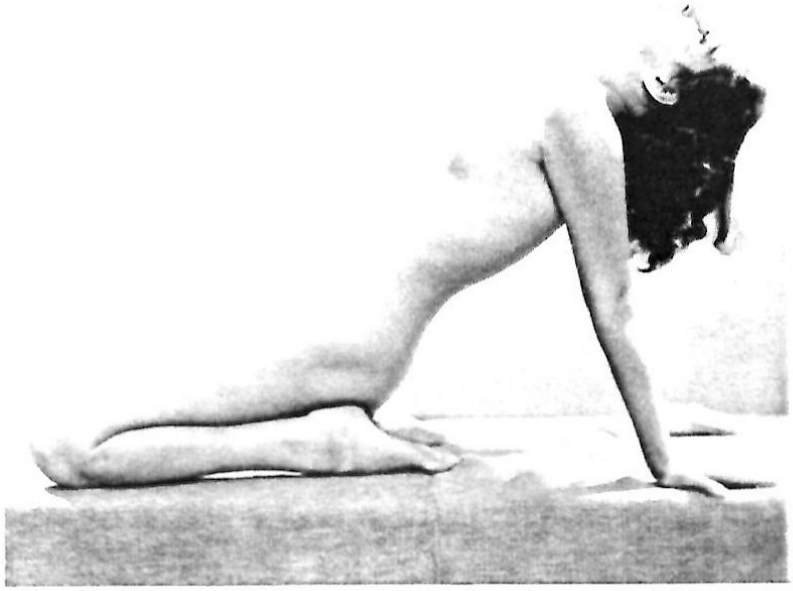

FIG. 45.—BEARING DOWN.

FIG. 46.—BEARING DOWN.

To follow page 136.

PLATE XI

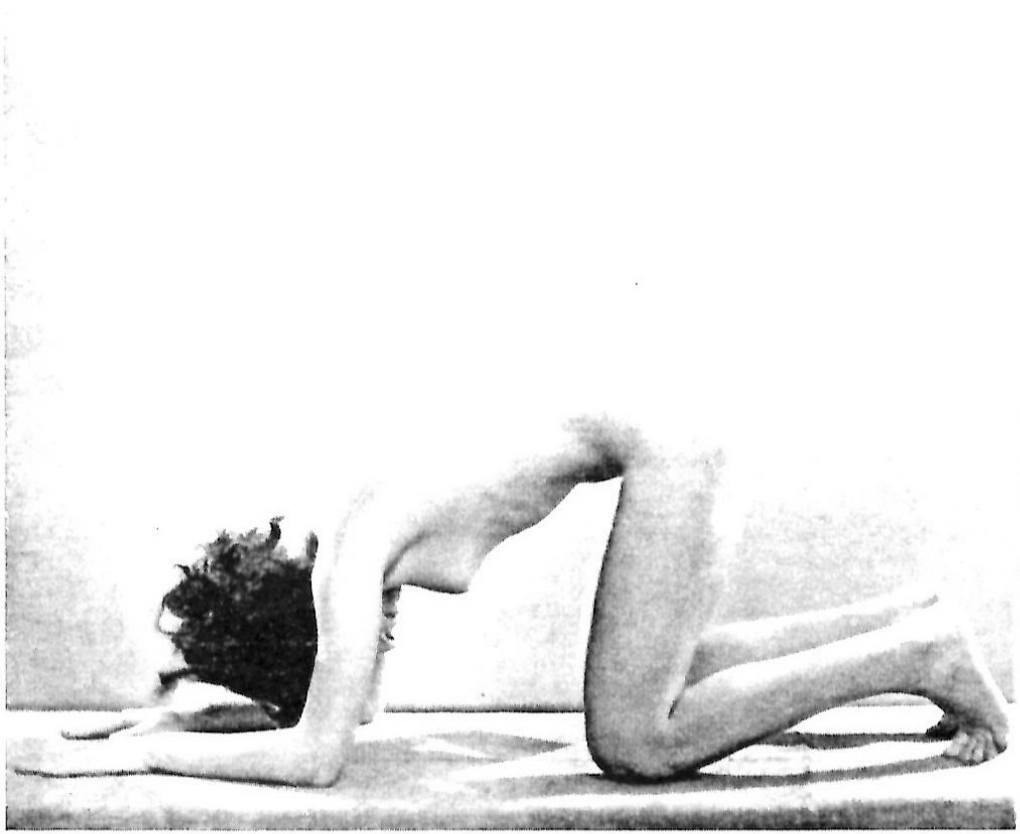

FIG. 47.—RESTING—ALL WEIGHT TAKEN OFF PELVIC FLOOR.

FIG. 48.—DELIVERY.

To face Plate X.

Kneeling is the commonest natural position, and is always varied according to the stage and rapidity of the process, the patient swinging forward to hands on the ground in front, or swinging back to hands on the ground behind. (See Dr. Trant's letter.)

On knees and hands (all fours) the birth is slowed down and all pressure is taken off the perineum, while with knees apart the sub-pubic angle is stretched open to allow the head to pass under the pubic arch.

So we have—

Squatting suitable to the first stage of labour as an assistance in dilatation.

Kneeling suitable as giving fullest liberty to the sacrum.

All fours best adapted to slow down the birth, and for the passage of the head as it takes pressure off the perineum.

In practice the employment of a low rocking-chair facilitates these changes in posture. The patient can be either seated upon it with feet apart or she can be kneeling on the ground, using the seat as a movable support for the arms. In both these positions the pelvis is free to swing on its pivots, and does so without effort as the chair moves.

Some of the obvious advantages of the natural positions in labour are:

1. Shortening of the birth process, which is advantageous for both mother and child. Absence of shock and fatigue.

2. Less likelihood of sepsis, because less bruising and less interference needed. All discharges escape at once. The position is inimical to infection, since the organisms would have to pass upwards.

3. The mother sees the child when born; this helps uterine contraction, besides stimulating her. The difference between a woman who sees the result of her pains at once, and the woman who is not allowed to see the child till nurse has taken it away and washed and dressed it, must be seen to be appreciated.

No less an authority than Dr. Henry Jellett, late Master of the Rotunda, in his book on "Maternal Mortality," says that our modern practice of confining the patient lying on her left side is wrong. He says:

"I think, however, that the woman will deliver herself with

less effort when she assumes the squatting position during the second and third stages of labour than when she is lying on her side in bed."

He points out that the squatting position has been used for more thousands of years in the world's history than delivery in bed has been adopted for tens of years, points out the analogy between defæcation and childbirth, and traces the universal constipation of civilized life and the difficulty now experienced by all civilized women in childbearing to the neglect of the squatting position.

Could we have stronger testimony?

Obviously the natural position has to be one safe for the mother and child when *alone*.

Upon her knees the woman sees the head as it appears, the crown pointing upwards, and can help its delivery with her hands placed one on each side of the neck, a traditional method of carrying the new-born infant still practised by the midwife in French maternity hospitals.

We must keep in mind the sameness of the process of parturition with that of defæcation. The same muscles are used in both, but in one the *vis a tergo* is the uterine muscle, in the other the intrinsic muscles of the intestine. In both cases they are aided in their task by the abdominal muscles and by *posture*.

Neither process can be perfectly performed unless the posture in which it takes place is favourable—viz., one in which the pelvis is stretched to its fullest capacity, thus inviting the contents to descend into it prior to their evacuation.

The squatting position, which if used only once daily will expand, develop and preserve the natural mobility of the pelvis, is neglected by the civilized both of the ancient and modern world, and the rigid pelvis with stiff and often anchylosed joints is the result. Confirmation of the correctness of this view is afforded by the fact that all over the world where the natural posture is used habitually for defæcation there childbirth is easy. The morning evacuation may be deposited in the ditch behind the house, as in most Scotch crofts, or amongst the crops, as in rural districts in India, or, as on the Continent, in country hotels closets are always provided for "the squatter." With the introduction of the modern closet, whose seat tends to get higher and

PLATE XII

FIG. 49.—DELIVERED.

To face page 138

higher, childbirth in those places has become increasingly difficult, and dental caries is common. One could make a long list of diseases dependent on the stagnation of intestinal contents which have developed at an alarming rate in the same districts, but my point is that efficient defæcation, efficient childbirth and proficiency in athletics all go together and are dependent upon a mobile, well-exercised pelvis.

By remembering this analogy with defæcation it will readily be conceded that the most favourable posture for birth must obviously be one in which the pelvic joints are allowed the fullest freedom of movement so that they can both *separate* and *swing*.

For the human pelvis swings on the hip joints much as a ship's candle swings in its socket.

There is also a second swing, that of the sacrum, the movement being centred around the pivot joints in the sacro-iliac articulations, which we have seen are so well marked in habitual squatters.

These two swings have different purposes—the swing of the pelvis on the hip joints keeps the birth canal in the desired position to hasten or retard labour, while the swing of the sacrum accommodates the size of the birth canal to the fœtal head as it passes through it.

As the suboccipito-bregmatic of the fœtal head passes into the maternal brim (which in every properly exercised woman it should do long before labour) the top of the sacrum goes back. As the head reaches the midplane the ligaments distend, and as the head reaches the outlet the tubera ischii separate, the subpubic angle is consequently increased, the inferior end of the sacrum with the coccyx is pushed back and the head is born.

Again, in order to hasten labour, the birth canal must be in such a position that the force of gravity helps, not hinders—*i.e.*, standing, squatting or kneeling.

On the contrary, to retard labour the axis of the birth canal must be so placed that it forms an angle with the horizon, and the woman therefore kneels forward with hands on the ground, practically on all fours, and thus she slows down the process.

All that delicate mechanism is upset by making the woman lie down in labour.

One thing is certain: there can be no one fixed position, for birth is a succession of *active* movements.

A confinement should not be a passive lying in bed, but an active series of purposive exercises skilfully performed, with already loosened joints and previously exercised muscles. There is in every natural confinement a marked restlessness; the patient stands, squats, kneels, places hands on the ground, and unless watched carefully from beginning to the final completion of this series of purposive actions we are liable to be mistaken as to *the* natural posture.

Nevertheless the lateral or "position Anglaise" is better than the dorsal decubitus as regards care of the perineum just because it slows down the labour and allows the attendant every chance; but it is *not so good* as kneeling on all fours with trunk bent forward, which *removes all weight* from the perineum.

The natural postures adopted by woman left to herself for the delivery are the squatting, crouching, kneeling and on all fours positions. Directly assistants come into the picture we get sitting, lying on back, then on the side, whereas the woman, when she is alone, instinctively adopts the best posture for herself and the child. The woman with attendants is obliged to take up the posture the *attendants* find best and most convenient for *them* to attend upon her, hence the change from the ground to the chair, from the chair to the bed, from the bed to the operating table.

We know how difficult most patients find it to use a bedpan successfully, and in the same way the recumbent position hampers a woman in labour. The force she can exert has to be enormously increased, as she must now propel the child upwards. Besides this the normal expansion of the pelvis is checked by contact with the bed, and in the lateral decubitus we not only have the free movement of the sacrum limited, but the stretching open of the sub-pubic angle is almost impossible.

In confinement on the back all the weight is on the woman's spine and big vessels as they cross into the pelvis. The perineum becomes engorged owing to this pressure, it is then pushed in front of the head.

It is common knowledge how the passage of a constipated motion can cause swelling of the anus, and the same swelling characterizes the patient's pelvic floor and perineum when labour

is slow; and this delay with its long-continued strain on the child's head, the engorgement, tearing and bruising of the mother, is the direct result of the recumbent position, whether she lies on her side or back.

The natural position is more difficult for the attendants, but I think this can be overcome, and the advantage to the perineum is at once apparent and the absence of need for interference.

I am confident that if we would only adopt the natural posture during the birth of children, most of our troubles would disappear. Puerperal sepsis, the chief cause of our three thousand five hundred maternal deaths, would soon be a thing of the past.

But beliefs and customs regarding childbirth are so immutable, one might truly allude to them as superstition, and any departure from accepted teaching is not only not to be tolerated, but is condemned out of hand. It would be impious to reason. And yet, what is here suggested is merely a return to nature and the conduct of a natural process as women have conducted it for themselves from the beginning of the world.

Are our present official efforts to make childbirth safer successful? I will not say to make it easier, because we have ceased to expect that. Surely it is a sign of failure that we seek to provide chloroform for every mother.

We are turning a perfectly natural process into a matter more complicated (and more expensive) than any disease, and with all our efforts we have to admit that the last twenty-five years have not seen an improvement in our maternal mortality figures.

Adopting the natural position for birth of course is no *cure* for the oval pelvis and for stiff joints. The blame for such things must lie on the shoulders of those who brought the patient up, *her mother above all,* then her school. They have made her what she is when childbirth overtakes her, and is thought of for the first time seriously. In England and America childbirth is often regarded even by the happily married as an unforeseen calamity.

Long before her marriage the over-civilized woman has been provided with an oval pelvis and stiff, if not anchylosed, joints. Fortunately much may yet be done by exercising these joints, which, if not completely rigid, become more pliable during pregnancy, and the most should be made of this loophole of escape from a difficult and disastrous labour.

Who then is to blame for our present high rate of maternal mortality? *Not the doctors and midwives*. The persons primarily in fault are those who brought the girl up—the mother and her teachers—and it is due to errors made in this early period, when the child was growing, as regards food, light and exercise, that at puberty she finds herself with an oval pelvis, stiff joints, bad teeth and faulty gait.

Much of the trouble is due to the late age now customary for marriage, which would not be of such grave import if the pelvis were well formed and the articulations supple, but it is these oval pelves with stiffened joints in the elderly and unprepared mother that make childbirth so difficult.

But the two outstanding habits of civilization, which destroy the natural shape of the pelvis, are (1) neglect of the squatting position for defæcation, and (2) the wearing of high heels.

In France, village school latrines are provided which must be used in the squatting position, which is the custom both in country districts and in the suburban hotels. Appendicitis is rare. In the big towns all over Europe the closet with a high seat is beginning to be used, and constipation, appendicitis and difficult childbirth are becoming as common as they are in England and in America.

I repeat once more that we have to realize that the act of defæcation and the act of giving birth are the same action. The same muscles of the abdomen and pelvis are used, the same movements of the joints take place, therefore the daily practice of the natural posture needed for one will keep the pelvis supple and prepared for the other. This habit of squatting will become popular when it is understood what an excellent training it is for all forms of athletics and sport, as it keeps the muscles and joints in condition.

As to heels, *any* heel increases the lumbar curve and the falling forward of the sacrum. Heels on women's shoes are often over four inches high in this country, in America a ten-inch heel has been seen. The wearers then walk perpetually on tiptoe, and have a compensatory lumbar curve, so that the bones of the lumbar vertebræ lose their natural form and become fixed in their unnatural position. The wearing of heels thickens the ankles, the tendo-Achilles becoming permanently shortened so that flexion of

the foot on the leg is limited. With this tiptoe posture goes relaxation of the utero-sacral ligaments and displacement of the pelvic organs.

Obviously the obstetrician cannot rectify the faulty shape of the adult pelvis, but he can do something for the pelvic joints to increase their mobility, and the question of posture in labour is entirely in his hands. Much depends upon it, as does the avoidance of sepsis after delivery. The doctor, of course, will be expected to indicate the lines on which children should be brought up from birth, that perfect pelvic form and mobility may be secured.

As we have seen, the perfectly round pelvis depends upon adequate food, light and exercise during the first years of life.

Diet.—The first food is of great importance and should be the mother's milk. This is increased in potency by light on the skin of both mother and the infant receiving it. After that, milk (unboiled) from the goat or from the cow should be the staple food of childhood. Nothing else equals it in value.

Too much can be made of the food question, and the attempts made to replace essential elements by artificial substitutes are bound to fail. It is forgotten that an inadequate diet indoors is adequate if the life is lived in the open air. The one article of food I would unhesitatingly condemn is the so-called bread of civilization. Most people do not know what real bread should be like; they have always eaten white bread made of flour from which the germ is removed, and which has been bleached with chlorine gas to make it white; it is simply a starchy addition to more palatable food. Starch in the diet increases the liability to rickets (Mellanby). Bread should be made from the whole grain of this year's harvest. Failing this, children will readily take steamed wheat, eaten with milk and brown sugar. Research is needed to discover why all dwellers in cities crave for devitalized food. Deprived of sunlight on the skin they seem unable to digest wheat.

Light and Exercise.—Too much clothing both cuts off light from the skin and hampers free movement.

First-rate men and women cannot be reared indoors. The athlete and the mother have the same requirements—sunshine, exercise, natural food.

Perambulator and cot prevent the infant kicking, crawling and rolling, and from trying to hold up its head. An infant should be able to change its position at will. Perpetual lying on the back gazing at the sky is quite unnatural to a healthy child. A tight napkin prevents free movements of the hip joints and of the abdominal muscles, much as the corset belt does later on.

Premature efforts to make the child stand are bad, and help to develop that pernicious forward tilt of the sacrum, which will be increased at school and made permanent by long sitting.

Our traditional method of conducting the education of our children by insisting upon their sitting still indoors to learn, instead of being out of doors in the sunshine, is responsible both for dwarfing, for rickets, and for pelvic deformity. As we saw, the maintenance of one attitude for long periods without change (as in the case of the Zulu girls) can deform the pelvis, but most town dwellers develop rickets. This is shown by the presence of decayed teeth and faulty gait.

At school, instead of carious teeth being regarded as a demand for more outdoor life—the child is told to brush them, quite regardless of the fact that the best teeth in the world belong to the non-toothbrush users, who rub teeth and gums with their fingers and swill their mouths out with water after every meal.

All exercise is good for the growing child, whether boy or girl, especially those in which the muscles of back, thigh and pelvis are used, as in swimming, riding (astride of course), the climbing of trees, of hills, and of ropes.

Field work, such as picking up stones with both hands, is to be recommended, so is weeding and hoeing, which all involve movement of the sacrum. As it swings into the counter-nutation position the true conjugate is lengthened and favours the maintenance of the circular shape of the brim.

The backache so often felt by the civilized after a little weeding shows how rigid are the joints of the lower lumber vertebræ and the sacro-iliac articulations.

What we need is a return to the land as the only efficient nursery for the young.

Just as the embryo passes from stage to stage as it develops *in utero*, the infant and young child should be reared on the same evolutionary principles. Rolling, crouching, squatting,

climbing, running, and swimming must be encouraged—in fact, all the activities proper to natural man as he passes through the stages of his gradual development.

The requirements of children are not those of civilized man, but of primitive man, and if the early life has been wanting in proper food, exercise and outdoor life, the want cannot be repaired after adolescence is reached. The girl will be a mother, but her confinement will be unnecessarily painful; the boy may be an athlete, but never a first-class one, because the perfect poise of the human body is dependent upon the easy swinging of the sacrum on its iliac hinges and the swinging of the pelvis itself on the hip joints. This balance and free movement is as essential to the highest skill in games and athletics as it is to the proper performance of childbirth.

Just as the natural position on the ground was abandoned in favour of the obstetric chair when it became usual to have a special attendant on childbirth, so our latest idea that every woman must be confined in a hospital with obstetrician, anæsthetist, midwife and nurse in attendance makes the recumbent position necessary. The process becomes daily more complicated and expensive. Yet my observation both of East and West leads me to believe that woman herself prefers confinement in her own home amid familiar surroundings where she can keep an eye on her household. This means she must be attended there, and the only person who can be with her all the time is the midwife.

Therefore the better training of midwives and the raising of their status is an urgent necessity. We must aim at securing natural births rather than provide for abnormal ones, bearing in mind that this policy is as much in the interest of the *child* as in that of the mother.

Much more study is needed of the process of natural birth. Childbirth is really a gymnastic feat, and no one, even the most sanguine, would expect to be successful without some preparation, study, and, above all, practice of the postures or stance necessary to perform the feat most easily. All the diagrams and treatises on the subject will not help us if we have not grasped the significance of that series of actions which follow one another rhythmically in every normal parturition and which have for

their object the conversion of the pelvis with supple joints into the cylinder of uniform calibre down which the infant travels head first.

Surely our troubles are largely due to the fact that in this one branch of medicine we will not retrace our steps and learn from nature rather than from books.

Tradition is preferred to reason, a legacy bequeathed to obstetrics by mediæval scholasticism.

Lastly, I would say that all progress is hampered by the attitude of *women themselves* towards the question of maternal mortality. It is too often an apathetic and fatalistic one. They are not interested and think it best not to enquire too closely. Let them realize that they bring up the young, and therefore it is they who mould the pelves of the coming generation of mothers. Let them reflect upon the fact that they themselves are the ones to blame for difficult birth and for our decreasing number of boys, and that upon them rests the responsibility for the birth of so many children handicapped for life by birth injuries, and, worse still, for our ever-increasing number of mentally defective citizens. Yet some still think that the pains of childbirth are a punishment for sin, nuns are forbidden to assist at a birth, and no religious or philanthropic order has ever been bold enough to make its chief work the attendance on women in childbirth.

The saint and the criminal, the family, the race, the nation, all mankind pass through the pelvis of woman and are what she makes of them.

A faulty mould does not produce good bricks however fine the clay.

BIBLIOGRAPHY

Adair : Ossification Centres of Fœtal Pelvis, *Amer. Journ. Obstet. and Gyn.*, vols. lxiv. and lxxviii., etc.

Pelvic Measurements, *Amer. Journ. Obstet. and Gyn.*, vol. ii., 1921.

Aitkin : The Growth of the Recruit. 1887.

Allport, W. H. : A Study of . . . the Human Pelvis, *Chicago Med. Rec.*, vol. xxxiv., 1912.

Amsterdam Conference Obstetrics and Gynæcology. 1899.

Annual Medical and Sanitary Reports : New Zealand, Falkland Islands, Jamaica, Cyprus.

Baker, Alfreda : The Factors Involved in the Production of Intra-cranial Birth Injuries, *Journ. Obstet. and Gyn. of Brit. Emp.*, vol. 33.

Bartel and Ploss : Woman.

Bates, Mrs. Daisy, O.B.E. : Letter *re* Confinements of Women of an Australian Cannibal Tribe.

Bell, Sir Chas. : The People of Thibet.

Boas : The Relation between Civilization and Stature, *Amer. Acad. of Medicine.*

Brailsford : Radiology of Bones and Joints.

British School of Archæology in Iraq. 1935.

Brook, Ralph : *Proc. Royal Soc. Med.* 1934.

Brooke, St. John : *Journal of Anat.* Vol. 58, 1923-4.

Browne, F. J. : Edin. Obstet. Trans. 1920, 1923.

Budin and Varnier : *L'obstetrique*, vol. ii., 1897.

Caldwell, W. E., and Molony, H. C. : Anatomical Variations in the Female Pelvis, *Amer. Journ. Obstet. and Gyn.* 1933.

Campbell, Janet : Report on Maternal Mortality. 1927.

Carnegie Trust Report on Metab. and Growth from Birth to Puberty. 1902.

Carnegie Trust Report on Phys. Welfare of Mothers and Children. 1917.

Charles, Havelock : The Influence of Function, *Jour. Anat. and Phys.*, Oct., 1893.

Remarks on the Morphology of the Lumbar, Sacral and Caudal Regions of the Punjabi, *Scientific Memoirs*, vol. 8, 1894.

Chick, Harriet : Rickets in Vienna, *Med. Res. Coun.*, 1923.

Clapon : *Journ. Obstet. and Gyn.*, 1922.

Clarke, T. H. : Prehistoric Sanitation in Crete, *B.M.J.*, 1903.

Combe, J. A. : A Thibetan on Thibet.

Cunningham : Anatomy.

Cyriax, E. F. : On the Anterior and Posterior Tilt of the Pelvis in Children, *Brit. Journ. Children's Dis.* 1924.

Dalyell and Chick : Hunger Osteomalacia in Vienna, *Lancet*, Oct. 22, 1921.

Darling, M. : Rusticus loquitur.

Darling : Sacro-iliac Joints, *Journal of Radiology*, Dec., 1924.

Davenport, C. B. : Human Metamorphosis, *Amer. Journ. Phys. and Anthrop.*, vol. 9, 1926.

De Garis, Mary : Painless Labour, *B.M.J.*, 1928.

De Lee : Principles and Practice of Obstetrics.

De Souza : Measurements of the Pelvis, *Biometrica*, vol. 9, 1918.

Derby, D. E. : Note on Accessory Articular Facets between Sacrum and Ilium and their Significance, *Journ. Anat. and Phys.*, vol. 45.

Dingwall : Artificial Cranial Deformation.

Discovery Report on Tristan da Cunha : Colonial Office.

Dorland and Hubeny : X-Ray Atlas of Obstetrics.

Drower, Mrs. : Letter on Childbirth in Iraq.

Duncan : Researches in Obstetrics. Edin., 1868. On the Os Sacrum, pp. 55-82 ; On Development, pp. 95-113.

Eardley Holland : Report to Med. Res. Counc. on the Causation of Fœtal Death. 1922.

Eden, W. : Maternal Mortality, *B.M.J.*, 1929.

Eden and Holland : Obstetrics.

Ehrenfest : Birth Injuries of Child. 1931.

Engelmann, G. J. : Labour among Primitive Peoples. 1883.

Exodus, chap. i. 16.

Fabre : *Précis d'Obstetrique*, vol. i.

Fairbairn : Obstetrics.

Feldman : The Sacrum, *B.M.J.*, 1932.

Fitzgibbon : Contracted Pelvis, *B.M.J.*, 1924.

Fletcher, W. : *Practitioner*, 1932.

Flinders, Petrie : Research in Sinai.

Goldthwait, J. E. : Pelvic Articulations, *Journ. Amer. Med. Assoc.*, Chicago, 1907.

Importance of the Joints of the Pelvic Girdle, *Month. Cycl. and Med. Bull.*, 1909.

Hall, Rosetta S. : Posture in the Preservation of the Perineum, *China Med. Jour.*, Sep., 1927.

Harris, H. A. : The Comparative Aspect of Growth in Children, *Lancet.*

Anatom. and Phys. Char. and Development of Children between the Ages of 7 and 11.

Cod-Liver Oil and its Vitamins . . . Rickets, Bone Formation and the Osteoblast, *Lancet.*

Harris (Iowa) : Studies in Child Welfare.

Hastings, Violet : Letter on Maori Childbirth.

Heber, Mrs. : Letter on Childbirth in Ladakh.

Heiberg : Science and Mathematics in Classical Antiquity.

Hess : Influence of Light in Prevention and Cure of Rickets, *Lancet*, 1922.

Hess and Unger : *Journ. Amer. Med. Assoc.*, 1921.

Hess and Weinstock : Antirachitic Value of Irrad. Cholesterol, *Journ. Amer. Med. Assoc.*, 1923.

Hill, L. : Sunlight and Open Air.

Hrdlickla : Bureau American Ethnology, 1908.

Hutchison and Stapleton : Late Rickets, *Brit. Journ. Children's Dis.*, Mar., 1914.

Hutton, Mrs. Elmslie : With a Women's Unit in Serbia.

Jarcho, Julius : Postures and Practices during Labour among Primitive Peoples.

The Pelvis in Obstetrics.

Jellett, H. : Maternal Mortality. 1929.

The Radical Cure of Pelvic Deformity, *Surg. Gyn. and Obstet.*, vol. 29.

Jenness : The People of the Twilight.

Johnston, H. : The Uganda Protectorate.

Junod, Henri A. : Life of a South African Tribe.

Kanner, Leo : Folk Lore of the Teeth.

Keith, Sir A. : Man's Posture, its Evolution and Disorders, *B.M.J.*, 1923.

The Pelvic Floor.

Lane, Clayton : *Lancet.*, 1907-8.

League of Nations Report on Prevention of Stillbirth and Infant Mortality, *B.M.J.*, 1930.

Le Damany and Lane : *Journ. Anat. and Phys.*, 1910.

Leicester, J. C. H. : The Relative Sizes of the Maternal Pelvis and of the Fœtus in Europeans, Eurasians, East Indians and Bengalis, *Lancet*, 1907.

Leslie-Milne, Mrs. : The Palaungs of the Shan States.

Lorimer, Mrs. : Letter on Confinements of Hunza Women.

Luce : Vitamin D in Cow's Milk, *Biochem. Journ.*, 1924.

Lynch : The Pelvic Articulations during Pregnancy; Labour and the Puerperium, an X-ray Study, *Amer. Journ. Obstet. and Gyn.*, vol. 30, 1920.

Macphee, Graham : Dental Caries. 1935.

McCormick : On Pelvic Outlet, *Amer. Journ. Obstet. and Gyn.*, June, 1926.

McKinley : Public Health Report, No. 55, Some Statistical Aspects of Infant Mortality.

Martin, F. H. : The Perpendicular Pelvis, *Journ. Amer. Med. Ass.*, 1910.

Maxwell, P. : Further Studies in Adult Rickets, *Proc. Roy. Soc. Med.*, 1934.

Maxwell and Miles : Osteomalacia in China, *Journ. Obst. and Gyn.*, 1925.

McKinlay, P. L. : Some Statistical Aspects of Infant Mortality, *Journ. Hygiene*, 1929.

Medical Dept. U.S. Army : The Health of the Recruit, vol. 15, part i.

Medical Research Council : Health of Schoolchild, 1928; Diet and Health; Diet and the Teeth, 1929; Rickets in Vienna, 1919-22; Child Life Investigations, 1924; Influence of Diet on Caries in Infants' Teeth, 1931.

Meek, G. K. : A Sudanese Kingdom.

Mellanby : Diet and Health, *B.M.J.*, 1931; Influence of Diet on Bones and Teeth. 1916.

Merrill, W. J. : Distortion of the Pelvis from Posture, *Amer. Journ. Orthopedic Surg.*, 1918; *Atlantic Med. Journ.*, 1924.

Miles and Feng : Calcium and Phosphorus Metabolism in Osteomalacia, *Journ. Expt. Med.*, vol. 41.

Ministry of Health Reports :
Maternal Mortality, 1929, 1930, 1932, 1933, 1934, 1935.
High Maternal Mortality in Certain Areas, No. 68, 1932.
Public Health Report, No. 55.
Mental Deficiency, 1929.
Health of School Child. Annual Reports.

Morton, Dudley, J. : *Journ. Bone and Joint Surgery*, 1932.

Mummery, J. R. : *Trans. Odont. Soc., G.B.*, 1869.
Report on Tristan da Cunha.

Murray : The Effect of Material Social Conditions . . . upon Birth Weight and Birth Length.
Influence of Diet on Caries in Children's Teeth.

Pan, N. : Measurements of the Pelvis in Hindu Females, *Jour. Anat.*, vol. 43, part ii., 1929.

Partridge, Joan : Stillbirth due to Intracranial Injury, *Jour. Anat.*, vol. 6, iii., 1929.

Partridge, Rev. A. : Letter on Tristan da Cunha.

Patchen, G. H. : The Pelvic Girdle its paramount influence . . . , *Amer. Ass. Med. Phys.*, vol. v., 192.

Piersol's Anatomy.

Pinard : Le bassin des boiteuses. *Clinique*, 1907.

Quain : Osteology and Embryology.

Report of Director of Public Health New Zealand.

Riggs : A Comparative Study of White and Negro Pelves. Johns Hopkins H. Res., 1904. Vol. 21.

Ripley : Races of Europe.

Roberts : Manual of Anthropometry.

Rollier : Heliotherapy.

Rosenhaim and Webster : The Sterols. 1926.

Scott, Agnes : Osteomalacia, *Journ. Tropical Hygiene*, 1916.

Shaw, J. C. M. : Ætiology of Dental Caries.

Shenton and Horowitz : *Lancet*, Feb. 16, 1924.

Sherman : The Dynamics of the Female Pelvis, Evolution and Architecture, *Amer. Journ. Obst.*, vol. 71, 1915.

Simpson, Sir A. R. : *Edin. Med. Journ.*, 1908.

Singer, C. : A Short History of Medicine.

Steenbock and Nelson : *Journ. Biol. Chemistry*, 1923.

Stenhouse, Capt. J. R., of R.R.S. *Discovery*. 1926.

Stephens, J. R. C. : Letter on Nigerian Childbirth.

Stoney, F. : *Brit. J. Radiol.*, 3, 345, 1930.

Swiss Statistics on Stature.

Testut : *Traité d'Anatomie*, vol. i.

Thoms, H. : The Obstetric Pelvis. 1935.

Thomas, B. : Arabia Felix.

Tinkelpaugh and Hartman : Parturition in the Monkey, *Journ. Comp. Phys.*

Turner : Index of Pelvic Brim, *Jour. Anat. and P.*, vol. 20, 1866 ; *Challenger* Report, 1886

Vaughan, K. : The Purdah System and its Effect on Motherhood. 1928.
The Shape of the Pelvic Brim as the Determining Factor in Childbirth, *B.M.J.*, 1931.
L'élargissement du pelvis dans la position accroupie, *Archives d'electricité medicale*, No. 588, 1933.

Verneau : Le bassin dans les Sexes et dans les Races. Paris, 1875.

Williams, J. T. : Normal Variations in Type of Female Pelvis and their Obstetrical Significance, *Amer. Journ. Obst. and Gynæc.*, April, 1922.

Williams, Whitridge : The Funnel Pelvis, *Amer. Journ. Obst.*, vol. 64, 1911.
A Consideration of some of the Factors Concerned in the Production of Deformed Pelvis, *Amer. Journ. Obst.*, 1918.
Obstetrics, Textbook of.

Wingate, Todd : Age Changes in Pubic Bone, *Amer. Journ. Phys. and Anth.*, vol. iii., 1920.

Witkowski : Histoire des Accouchements.

Wooldridge : Veterinary Science and Obstetrics.

Wulsin : Non-Chinese Inhabitants of Kansu, *Amer. Journ. Phys. and Anth.*, vol. viii., 1926.

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